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PC LABS TESTS

30 CD-ROM Drives

29 Sound Boards & 20 Speakers

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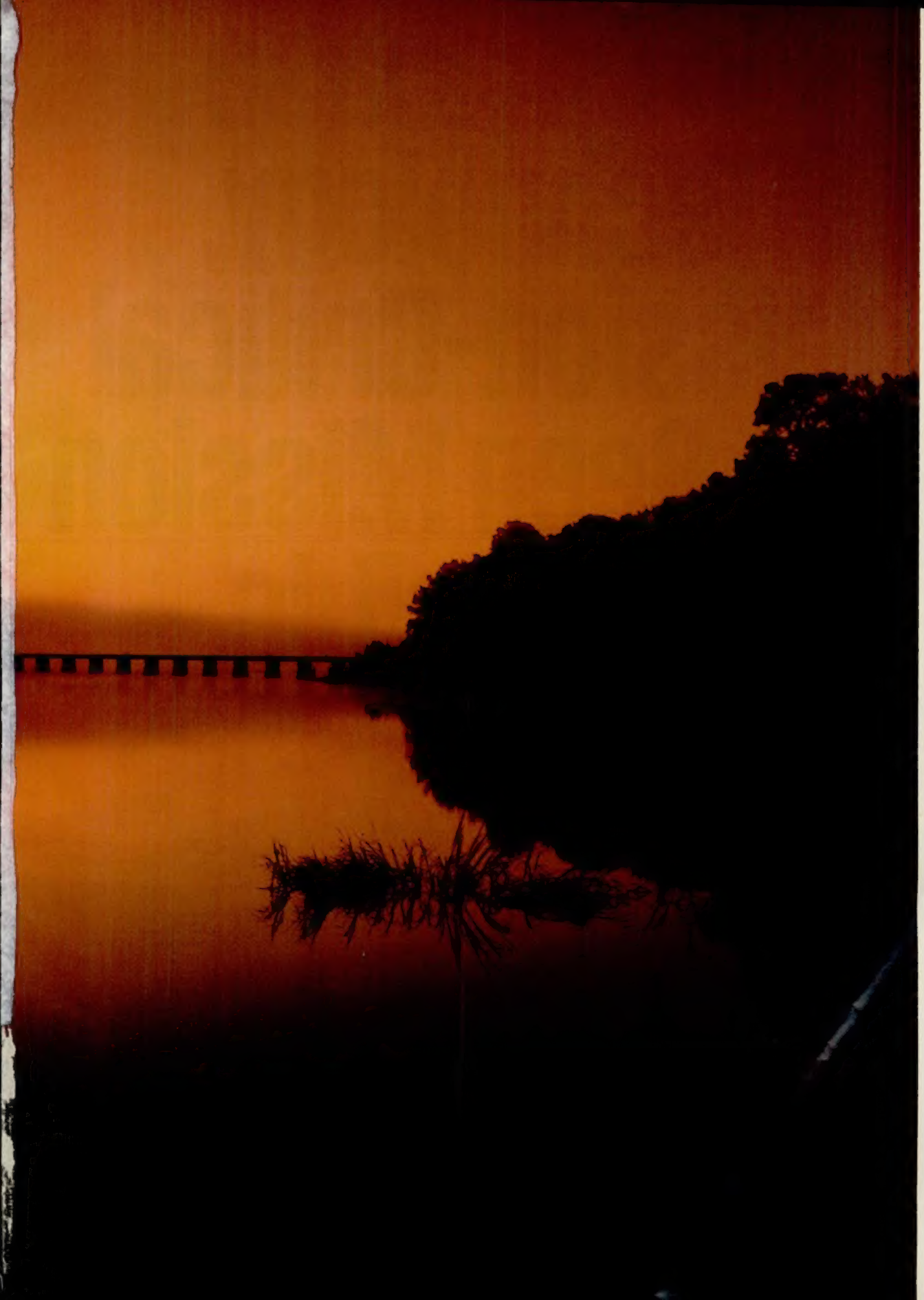

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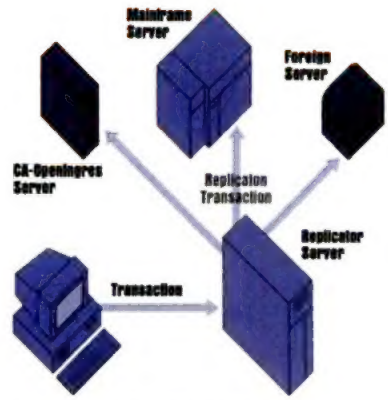

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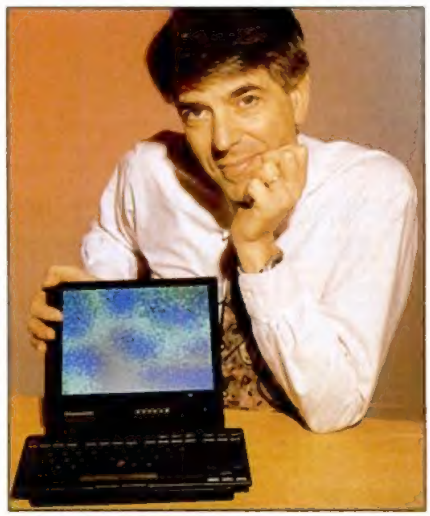
Inside

There are many ways to evaluate computer products—each with its merits. You can read a list of features and functions or, even better, examine the shipping product, as we do with nearly 500 products a year in our First Looks coverage.

Better still is to conduct labs-based, in-depth testing, as we do in our comparative reviews.

At *PC Magazine,* we devote most of our efforts to testing. We spend millions of dollars and tens of thousands of hours testing products in our sophisticated, carefully controlled labs, in both New York City and Foster City. This gives us the objective results we use to produce the reviews you read in every issue.

And yet that's not always enough to tell the whole story. Nothing compares with the experiences real users have living with products day in and day out—seeing whether the products are really robust, compatible, and usable in specific environments.



Out of the labs and into the real world: Bill Machrone takes a "second look" at products.

That *real* experience is just what Bill Machrone will tap into. Beginning in this issue, Machrone writes Second Looks—a column devoted to following what happens when you take a product out of the labs and into the real world. Machrone, who probably spends as much time as anyone in the industry talking to computer users both in person and on-line, is counting on feedback from all of you regarding what works and what doesn't. He'll be uncovering the real story behind selected products in each issue and letting us know which products he'll follow up for future issues—typically those that have earned Editors' Choice status or other awards.

"*PC Magazine* has always depended on reader interaction," says Machrone. "This is one more way for us to close the loop and share vital product information."

Second Looks begins right after Machrone's always thought-provoking, regularly appearing *PC Magazine* column. We think Second Looks deserves your look as well.—*Michael J. Miller*

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	Delphi		
Native code compiler for high-performance applications	✔	–	–
Creates standalone, redistributable .EXEs and DLLs	✔	–	–
No runtime interpreter DLL required	✔	–	–
Fully object-oriented programming language. Provides optimal code reuse	✔	–	–
No external tools necessary to build new components or extend environment	✔	–	–
Combines high-performance compiler, visual environment, reusable components, and scalable database tools	✔	–	–
Robust exception handling	✔	–	–
ReportSmith® "live" data reporting	✔	–	–
Local ANSI SQL-92 engine for server independent client/server development	✔	✔	–
Client/server version available	✔	✔	–

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COVER STORY

Multimedia *à la Carte*

BY LEON ERLANGER

You can't put off that multimedia upgrade any longer. Not when mainstream business applications such as Lotus 1-2-3 and Paradox for Windows come in CD-ROM versions with multimedia help, Harvard Graphics and Freelance Plus let you add sound and video to your slide presentations, and thousands of multimedia reference and education titles are available only on CD-ROM. But do you want to upgrade your entire system, buy a prebundled multimedia upgrade kit, or mix and match the components separately? In this story we show you the advantages and disadvantages of all three routes. In the stories that follow, we review CD-ROM drives, sound boards, and speakers, to show you how the components stack up.....**104**

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Cover photography: Thom O'Connor (top); Jeffrey Krein (bottom)

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COVER STORY

THE NEWEST SPIN ON

CD-ROM DRIVES

BY TED NEEDLEMAN

CD-ROM is not only here, it's a major part of the computing experience. Single-speed is out. Double-speed is in. Quadruple-speed is next. PC Magazine Labs tests 30 new CD-ROM drives—18 double-speeds, 10 quad-speeds, and a couple in between—to show you which can handle today's multimedia applications and which can handle tomorrow's **111**

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AN EARFUL OF

SOUND BOARDS

BY JOHN R. QUAIN

Two years ago, business users scoffed at the notion of adding sound to their workaday PCs. Today, everyone is scrambling to beef up existing systems with sound boards and speakers to meet the demands of software with narrated tutorials and CD-ROMs filled with sparkling sound and music. And the good news is that sound boards now offer better sound quality and fewer installation headaches. ZD Labs puts 29 boards through a rigorous test suite, and we tell you which ones ring true and which hit a sour note. We also steer you toward the best speakers..... **167**

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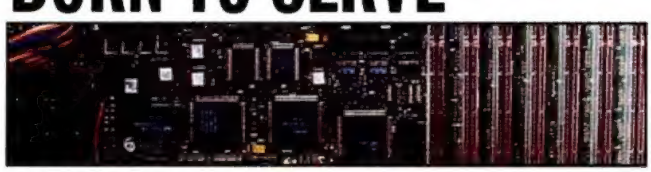
BORN TO SERVE



BY PADRAIC R. BOYLE

Serving files to a small workgroup can be a more demanding task than you might expect. But buying a server to handle the load doesn't necessarily have to cost a fortune; you can purchase a competent workgroup file server for just a few hundred dollars more than you'd pay for a standard desktop PC with a network card and lots of memory. We found seven workgroup file servers that were built expressly for that purpose, and we used our rigorous NetBench 3.0 tests to put them through their paces **218**

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The detail of EPSON's 2400 dpi, scanner really stands

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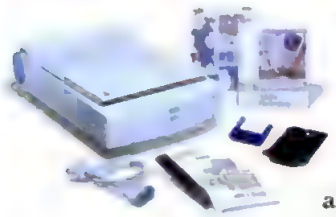

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PC Magazine Reviews

Except where noted: All *PC Magazine* reviews are of currently available products. Benchmark and performance tests are run on Compaq Deskpro 486/33M's.

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The network suite vs. the stand-alone suite.

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	PerfectOffice 3.0 Standard Edition	Microsoft Office 4.2 Standard Edition
Programs have consistent interfaces	YES	YES
Integrated E-mail, calendaring and scheduling**	YES	NO
Workgroup publishing features	YES	NO
Number of applications with OLE 2.0 support	Four	Three
Number of applications with on-the-fly spell checking	Three	One
Automated tasks that work independent of applications	YES	NO
Grammar checker can rewrite entire sentences	YES	NO
Intelligent find and replace	YES	NO
Ability to record scripts (macros) across applications	YES	NO
Supports both Visual Basic & AppWare programming tools	YES	NO
Six months of free, toll-free technical support*	YES	NO

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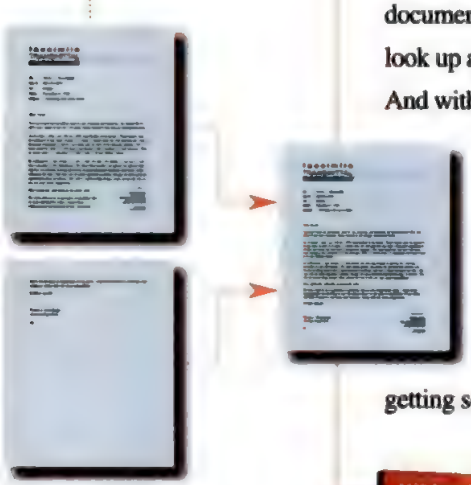

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CIRCLE 061 ON READER SERVICE CARD

Letters

PENTIUM BLUES

PC Magazine's cover story on Pentium versus 486 processors was very enjoyable ("For Love or Money," December 6, 1994). The coverage was broad and comprehensive, forming a definitive guide for choosing between machines using the Pentium processor and those using the 486. It was disappointing, however, not to see any mention of the Pentium's floating-point-division bug. This could be a major factor in the decision of which processor to get, which in turn would determine which computer system to buy. Despite Intel's claims, it's still an unsettling concern for all PC users, especially those who use computers for high-end applications.

Malcolm Koo
via the Internet

Your review of Pentium and 486 systems was interesting and informative. I take issue, however, with what you consider availability of on-site service, as shown in the Summary of Features. I've experienced a continuing array of problems with my Gateway 2000 machine. When I requested on-site service, I was told by Gateway that on-site service is provided at the discretion of the technical-support people, who in turn said that Gateway rarely sends anyone out. Problems are usually handled by having the customer return the unit for repair.

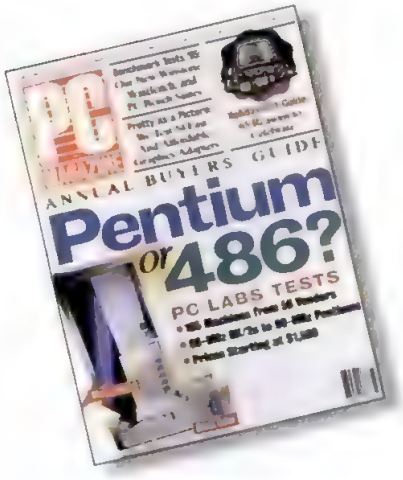
Robert L. Mrugala
Lockport, Illinois

It's surprising that you haven't provided coverage of the floating-point-division error in the Pentium. The business press has covered the issue ad nauseam but with little definition. I eagerly await the trademark depth of a *PC Magazine* analysis.

John M. Steele
Bloomfield Hills, Michigan

After hearing that Intel knew about the problem and yet continued to ship defective chips for over six months, I was stunned. I hope that *PC Magazine* will hold Intel's feet to the fire in this matter. Although I am not a member of the scientific community, I wonder if anyone would want to trust a bank or credit card company whose machines use a Pentium processor.

Steven Kelly
Cambridge, Massachusetts



Intel's claims aside, the Pentium flaw is unsettling for all PC users.

• Because of our lead time, we weren't able to include coverage of the Pentium flaw in our December or January issues, which went to press before the problems were uncovered. We covered the story in depth, however, in our February issues, and will continue to cover new developments.—Ed.

CURIOUS REQUIREMENTS

Your 1994 Holiday Gift Guide mistakenly describes DOOM II as "undemanding of your system resources" ("Solve, Shoot, and Puzzle Your Way to Holiday Gaming Happiness," December 6, 1994). On the contrary, DOOM II is one of the most demanding games ever developed. Id Software's *DOOM II Survival Guide* states, "For enhanced speed and better play value overall, a 486 or Pentium system with at least 8MB of RAM is recommended." Indeed, even my single-player games are very choppy in low-resolution mode on my 486SX/25 system with 4MB of RAM. That doesn't stop me from playing, though!

Blake Wilfong
via the Internet

SOFTWARE FOR WHOM?

"What Do Women Want?" asks an After Hours headline for reviews of software intended for women and girls (November 8, 1994). This one doesn't want the insulting implication that all of the software reviews she's been reading and enjoying were never meant for her at all. I don't think we need female-oriented software; we need people-oriented software. Yes, DOOM probably appeals to more boys than girls, but there's lots of entertainment software available today that should appeal equally to both sexes.

Debby Vivari
Rockville, Maryland

Gee, I thought I just wanted what every computer nerd wanted: good software at a decent price! Now I find that, once again, women are looked at as "other," with "other" wants. I found your article degrading and condescending. If my niece loves Commander Keen, why shouldn't my nephew love Hello Kitty? You're only serving to reinforce outdated stereotypes.

Sandra Richards
via PC MagNet

TAKE TWO WITH SECOND LOOKS

Bill Machrone really hit it on the head in "A Tale of Two Pentiums" (November 22, 1994). My own experience tells me that the difference between what I see advertised and what I get is indeed, as Machrone said, "the difference between going to the prom and getting married." If only you could divorce your purchases....

Gedas Vysniauskas
Dale City, Virginia

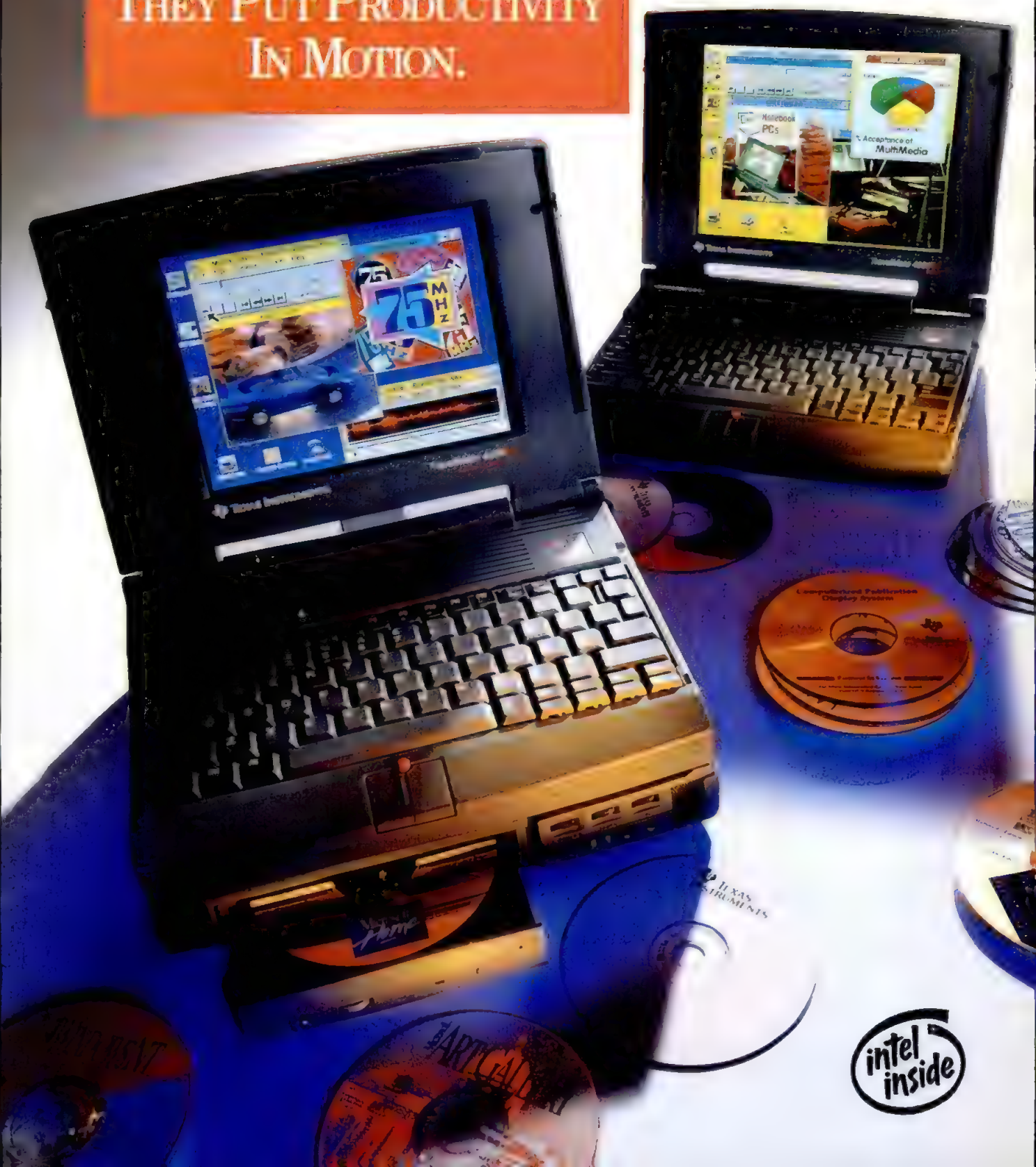
• Starting with this issue, we'll be featuring a new column by Bill Machrone that's appropriately titled Second Looks.—Ed.

PUZZLING PRINTERS

Congratulations on another excellent roundup of printers (11th Annual Printer Issue, November 22, 1994). The comprehensive story was both very informative and well thought out.

Alan W. Lawless
Lapeer, Michigan

They Not Only Sound Great, They Put Productivity In Motion.



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August 1994
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CIRCLE 304 ON READER SERVICE CARD

LETTERS

We've been somewhat intrigued, over here in the United Kingdom, by the regular appearance of one Norman Tebbit as a color-printer test image in your reviews.

Mr. Tebbit held a number of ministerial posts under Margaret Thatcher's administrations and was noted for his—shall we say—rather robust right-wing views on employment, Europe, race, and other issues. He fell out of favor following the demise of Ms. Thatcher and now lurks about the halls of the House of Lords, emerging occasionally to remind us that he's still around. Perhaps *PC Magazine,* U.K. Edition, should start using Ollie North as its test image.

Charles McLellan
via PC MagNet

• When we selected the photo, we were interested in the focus, color saturation, and contrast more than the content. Unfortunately, no one here ever asked whether the fellow was famous—or infamous, as the case may be.—Ed.

The otherwise excellent roundup of printers fails to evaluate an important operating characteristic of printers: the minimum margin size that can be printed on the page. This particularly affects people who may be considering an ink jet printer as an alternative to a laser printer, as laser printers can generally accommodate smaller margins.

Brian Zimmerman
via the Internet

Your roundup of printers states, "Perhaps the biggest news in lasers is the advent of color." Yawn. For at least some of us, the long-overdue bombshell in your annual printer issue was contained in the sidebar "Preview: The Tabloid-Size HP LaserJet 4V and 4MV," which announced the entry of Hewlett-Packard into the tabloid-size laser printer market. The significance of this will not be lost on your readers: Prices for tabloid-size laser machines will finally drop to affordable levels, making true publishing-on-demand possible for even small firms.

Lamont Downs
via the Internet

TWO STEPS BACK

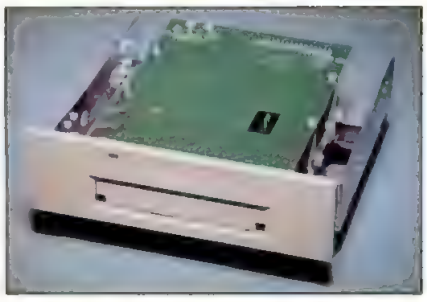
Much of the reader criticism of John C. Dvorak's suggestion that the government should break up Microsoft's monopoly of the software industry (Letters, November 22, 1994) assumes that Microsoft is the volume leader because of its quality and technical prowess. Yet nothing could be further from the truth. Lest we forget, Microsoft's domination of the industry was a direct result of its purchase of DOS from a Seattle developer and its decision to produce proprietary products for its captive user base. In this light, attempts to compare Bill Gates to Thomas Edison seem a bit strained.

William B. Fankboner
La Quinta, California

CORRECTIONS AND AMPLIFICATIONS

In "PCMCIA Connectivity: Socket to Us" (January 24, 1995), the standard used for Telephone Network Simulation testing of PCMCIA modems was TSB-37a.

The photograph accompanying the review of the Exabyte EXB-1500 in "The Bigger Backup" (February 7, 1995) actually shows an Exabyte EXB-8505XL, which is an external 8-mm helical scan drive. The correct photograph of the EXB-1500 is shown below.



In the screenshot caption for the review of No Hands Software's Common Ground, Version 2.0 (February 7, 1995), we incorrectly blamed Bitstream's TrueDoc engine for Common Ground's failure to preserve spacing information and did not indicate that this occurred only in the CorelDRAW graphic.

By popular demand, we're providing the Top Retail Software lists absent from our issues of February 7 and February 24, 1995. The lists did not run in those issues because of space constraints created by our extended coverage of the Pentium flaw. The top-selling packages for the week ending November 26, 1994, were OS/2 Warp, Version 3.0 (IBM Corp.), WordPerfect 6.1 for Windows Upgrade (Novell), Quicken 4 for Windows Deluxe CD (Intuit), UnInstaller 2.0 (MicroHelp), QEMM 7.5 (Quaterdeck Office Systems), Headstart Turbo Tax State '94 (Intuit), MS-DOS 6.22 Upgrade (Microsoft Corp.), WordPerfect 6.1 for Windows (Novell), Procomm Plus for Windows 2.0 (Datastorm Technologies), and WinCheckIt 2.0 (Touchstone Software).

The top-selling packages for the week ending December 10, 1994, were OS/2 Warp 3.0 (IBM Corp.), WordPerfect 6.1 for Windows Upgrade (Novell), Procomm Plus for Windows 2.0 (Datastorm Technologies), MS-DOS 6.22 Upgrade (Microsoft Corp.), TaxCut Headstart Edition 1994 (Block Financial Software), Quicken 4 for Windows Deluxe CD (Intuit), UnInstaller 2.0 (MicroHelp), QEMM 7.5 (Quaterdeck Office Systems), Photo Gallery 1.0 (Expert Software), and Do It Yourself Lawyer for Windows (Expert Software).

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Meridian 400 with unretouched photo of active matrix display.

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At just under four pounds, the ZEOS Meridian 400 subnotebook is molded from a special carbon-fiber material that cuts weight and improves durability. It offers you the perfect approach to traveling, working abroad, and everyday computing. As *PC Magazine* said: "The ZEOS Meridian…pushes a subnotebook's abilities to new heights."

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Meridian 800 with unretouched photo of active matrix display.

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Windows Magazine said: "With its sleek styling, solid construction and hot performance, the ZEOS Meridian 800C justifiably earns its place at the top...."

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- Lotus Organizer

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Color	**400C**	**800C**
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- 350MB IDE hard drive
- 3.5" 1.44MB floppy drive, 400: External, 800: Internal
- Custom carrying case
- Extra battery
- MS-DOS 6.2
- Microsoft Windows for Workgroups 3.11
- Lotus Organizer

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- 8K (DX4: 16K) internal system cache.
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CIRCLE 151 ON READER SERVICE CARD

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FILE SEARCH WINDOW SELEC

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Introducing the NEC MultiSpin® family of 4X CD-ROM readers. With their faster transfer rate and increased throughput, these machines respond to your commands with an unprecedented swiftness. As a result, video and animation can now flow more smoothly, while databases and business software react with a new speed and agility.

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NEC

4x

(QUAD-SPEED)

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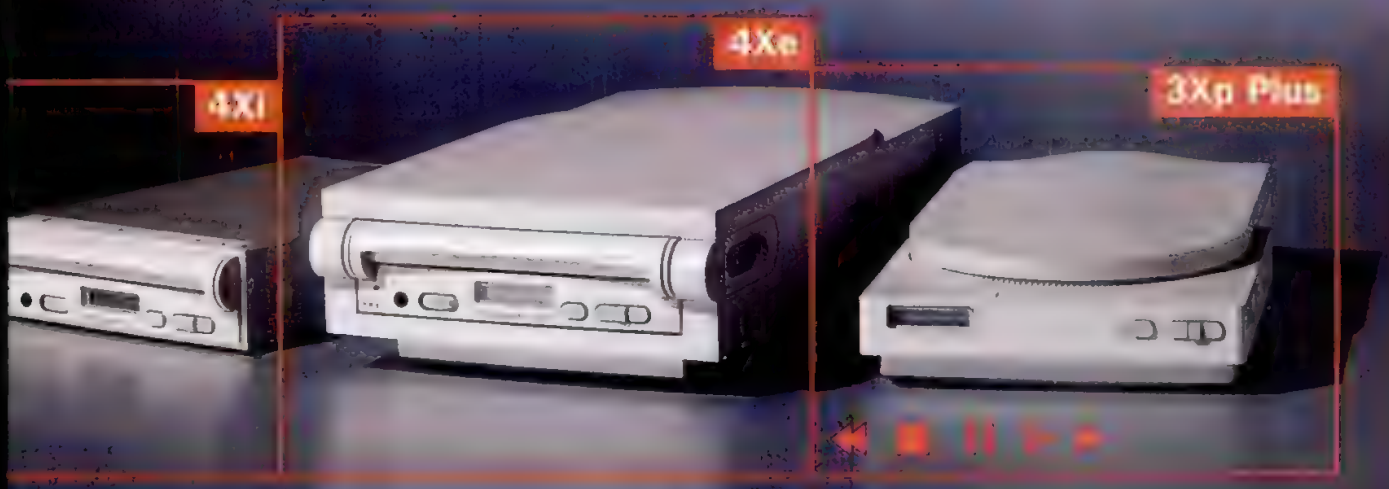

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CIRCLE 153 ON READER SERVICE CARD

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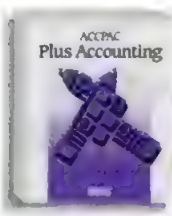

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CIRCLE 400 ON READER SERVICE CARD

A Thin Blue Line

Elusive blue laser promises high-capacity CDs.

The race for next-generation compact disk technology is well under way, with Sony Corp. and Philips Electronics recently announcing a joint proposal and Time Warner and Toshiba proposing another format for storing multiple gigabytes of information and entertainment on a single versatile disk. Both camps are vying for adoption by consumer electronics and computer companies—as well as Hollywood heavyweights—as the winner has the potential to replace music CDs, CD ROMs, and videocassettes. Even before this race has been decided, though, the next one has already begun.

A key to even higher-capacity disks is the blue laser, which has ideal properties for making the tiny pits that store information on disks but has eluded scientists for two decades. The red lasers used to make 650MB CDs today limit how precisely light can be focused in one spot. A laser with a shorter wavelength of light can make storage pits that are smaller and closer together, thus squeezing more data onto a disk.

The new Sony/Philips digital video disk format stores 3.7 gigabytes (135 minutes of video) by using a shorter-wavelength red laser. A dual-layer design developed in collaboration with 3M could double the capacity. The Time Warner/Toshiba "super density disk" holds 5 gigabytes (180 minutes of video) per side. The disks are formed by back-to-back bonding of two thin disks. The next challenge is to leapfrog these technologies with even shorter-wavelength blue and ultraviolet lasers that one day may pack ten times more data than either of the proposals on the table today.

The seeds for these future disks were planted in the 1970s when RCA Labs and Bell Labs conducted basic research into semiconductors related to blue light, but the field died completely by the end of the decade. Research gained momentum again a few years ago when new light was shed on the materials needed to produce blue lasers. Recently, at Boston University's Center for Photonics Research, Dr. Theodore Moustakas, professor of electronic engineering and physics, demonstrated a blue-light LED (light-emitting diode), a precursor to a full-fledged blue-light laser. Both lasers and LEDs are semiconducting devices that convert an electric current into a stream of light.

Boston University researchers are working with gallium nitride—a material that emits light naturally in the ultraviolet region. "The materials we are investigating are going to lead not only to blue sources, but also to ultraviolet sources, which have an even shorter wavelength. We anticipate that at some point in the future the amount of information you will be able to write on an optical disk will be higher by a factor of six. And there's a potential to exceed a factor of ten," says Moustakas.

Last April, Japan's Nichia Chemical Industries disclosed that it had developed a blue LED and had put it into production. They were first, but with a harder system to manufacture. "They're ahead of us in that sense," says Moustakas. "The only difference is that we've developed a new method of making and scaling up this process and avoiding some of the problems associated with hydrogen."

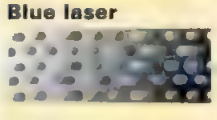
Graduate students in the Boston University lab are now working on a blue-light laser and expect to have a prototype of it ready early next year. Compact disks based on blue-laser technology could reach consumers around the year 2000. An industry-wide move to higher-capacity disks would probably not entail a squabble over competing formats such as the one taking place today, since the method of recording and reading information would not change. And that's a big advantage in the realization of the future multipurpose compact disk.

—Carol Levin

LASER SPOT SIZE

Shorter-wavelength lasers, such as blue and ultraviolet, reduce the distance between the tracks and the sizes of the pits on CDs, achieving greater storage density than red lasers. The Sony/Philips and Toshiba digital video disk formats each use a 635-nanometer red laser.

Ultraviolet laser
Wavelength: 240 nanometers
Diameter: 0.65 microns



Blue laser
Wavelength: 450 nanometers
Diameter: 1.2 microns

Red laser
Wavelength: 780 nanometers
Diameter: 2.1 microns

Source: Boston University Center for Photonics Research

DOUBLE-DIPPED DISKS

The Sony/Philips format (top) holds 3.7GB and could double its capacity using 3M Corp.'s dual-layer disk. The Toshiba format (bottom) uses back-to-back bonding of two 5GB disks.

Sources: 3M Corp., Toshiba America Information Systems Inc.

Pipeline *By Robin Raskin*

The Internet with a View

Nothing has propelled us faster into the next generation of computing than the World-Wide Web. In the early days of Mosaic—the first graphical front end to the Web—the Web was known for being hard to get onto and tough to navigate. The next generation of Web users is going to find itself hard-pressed to stay off of the thing.

That's because the next generation of Web tools won't depend on external browsers such as Mosaic and Netscape. You'll be able to browse in, and often publish on, the Web from within whatever application you happen to be using. Both Microsoft and WordPerfect have already announced that Internet browsers/HTML (hypertext markup language) converters will be built into their respective word processors. As Web fever spreads, we may never again be more than a keystroke away.

The Microsoft and WordPerfect options for browsing and creating HTML documents are seductive, but, in my never-ending search to impose order on chaos, I found that one of the most appealing Internet ideas comes from Lotus.

What do you get when you cross Lotus Notes with the Internet? Quite literally, you get the Internet with a view. Lotus is beta testing two killer-app Internet projects that tie Notes databases to the Internet.

The first is the InterNotes Web Server. This one takes your existing Notes database and, with a single keystroke, converts it to an HTML document. This means your Notes database gets published on the Internet with full-text search, views, access rights, and all those other Notesian capabilities. To update your HTML document all you need to do is refresh the link.

Though this first version of the InterNotes Server concentrates on publishing Notes databases on the Internet, Lotus plans a second version to take the databases into the electronic commerce arena. In essence, a Notes form posted on the Internet will allow you to buy, subscribe, and do your Internet business within a Notes workflow structure.

A second product, InterNotes News Gateway, turns Internet newsgroups into Notes databases. There are a couple of advantages to having Notes manage your newsgroups (*manage* is the operative word here). For instance, a network administrator can provide different newsgroup access to different groups, and you can use Notes agents to keep track of the newsgroups, alerting you when there's something you need to attend to. You can add your two cents to the topic and then replicate (a fancy form of copying) the whole thing back to the Internet.

Like the rest of the pack, Lotus is also planning a Web browser that you access from within Notes, but you can bet that the Notes version will display Web pages as some sort of Notes form.

It's hard to imagine the clunky interface of Lotus Notes meeting the elegant style of the Web, a true "beauty and the beast" story if there ever was one. But the marriage of Notes and the Internet may be the ticket that finally makes the Web a sensible place for doing business.

Robin Raskin is the editor of PC Magazine.

Europe Poised for On-line Expansion

THE BOOM IN ON-LINE SERVICES enjoyed by PC users in the U.S. is now crossing the Atlantic, as American services set their sights on the untapped European market and a new European player enters the stage. On-line subscribers in the U.S. will benefit as well, gaining access to more sources of international news and information.

Based in Luxembourg, Europe Online is backed by a consortium of content and financial companies, in addition to such European publishers as Germany's Burda Verlag, France's Matra-Hachette (Grolier, *Elle*), and Britain's Pearson plc (*The Economist, The Financial Times,* Penguin Books). The July launch of the service will use AT&T's Interchange Online Network as its platform for publishing information, and will support forums, mail, and Internet access.

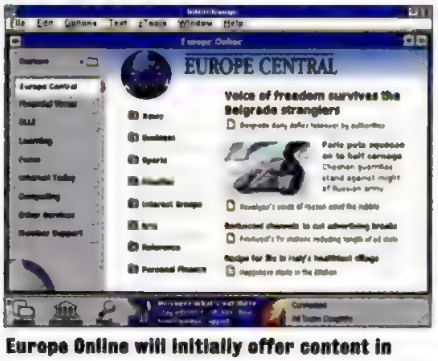
As Europe moves toward a common market, service providers are facing many of the same problems that the European Union is facing: issues of telecommunications deregulation and privatization and incompatible infrastructures. In Germany, for example, ISDN lines to the home are readily available, while in Italy, Touch-tone service is considered a scarce luxury.

"A local partner helps you navigate regulations and the local language," explains Douglas Peabody, a former vice chairman of America Online and president of Meagher Communications, a member of the Europe Online consortium. Another barrier is the scarcity of home PCs in Europe. While 30 percent of homes in the U.S. have PCs, the number ranges from 7 to 20 percent in Europe.

Though some would say that U.S.-based services are bound to fail, that's not stopping the invasion of U.S. on-line services. CompuServe, currently the only U.S. player with an international scope, has 200,000 European subscribers and is planning to expand its local-language offerings in France, Germany, and the United Kingdom.

Apple's eWorld, Delphi Internet Services, and The Microsoft Network also plan to bring on-line services to European shores.

"International expansion will become more and more important for U.S.-based services and content providers," says Mauro Calvi, product manager of international strategy for The Microsoft Network. "Many international markets, including Europe and Asia, are a great opportunity now." Microsoft estimates that almost 60 percent of its Windows operating systems are located outside the U.S. The Microsoft Network will be available in 25 languages and provide local-access phone numbers in more than 40 countries.



Europe Online will initially offer content in English, French, and German.

—Melissa J. Perenson

Faster, Cheaper Color Printing

WE ALL WANT COLOR OUTPUT. We've got it on our screens every day, but aside from graphic-arts applications, not many offices have taken the plunge and gone with high-quality color printers.

There are good reasons to hesitate. High-end thermal color transfer printers are expensive to buy, can cost more than $1 per page for output, may require special paper, and are slow—a page per minute at best. Ink jets are less expensive to buy and operate, but the output quality isn't as good, and those that are designed to work with plain paper have problems with ink soaking into the paper fibers and smudging when wet.

Color in 15 seconds.

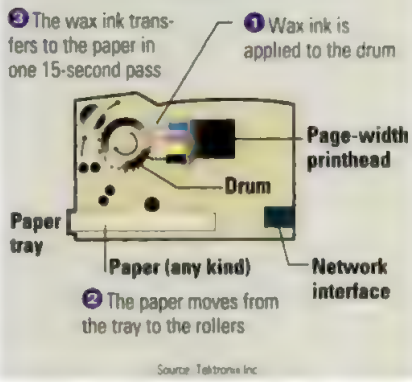
Color lasers are faster but they remain expensive to purchase and run. There are four separate imaging drums, four sets of toner, and four developer units, all of which make the paper handling much more complicated than in a black-and-white laser.

Tektronix has long had a reputation for innovation in color printing, and it has now come up with a totally new color printing technology. Like a black-and-white laser printer, it needs only one drum, and it uses ink jet technology based on economical solid-wax ink. Printers based on this new technology will create images in a way no other printer does.

Instead of spraying ink directly onto the paper, it will spray ink onto the imaging drum much the way an offset press works. All four colors—cyan, magenta, yellow, and black—are placed on the drum at one time with precise print heads that are as wide as the drum. That speeds the printing process. The ink image is then transferred from the drum to the paper in a process similar to that used in a laser printer or offset printing press. The single drum simplifies the paper handling and helps speed the printing process. Tektronix, which this month debuts the technology in its new Phaser 340, claims four pages per minute for color prints.

OFFSET PRINTING ON THE DESKTOP

Tektronix has developed a new color-printing technology that combines solid inks with offset-drum architecture to help bring low-cost color printing into the office.



At about 11 cents per typical page, the solid wax is less expensive than thermal transfer, and it remains relatively smudge-proof while providing vivid and saturated colors on media ranging from plain paper to overhead transparencies. —*Alfred Poor*

Top Retail Software

Current ranking	Last issue	Product/ company
1	--	**Turbo Tax Federal 1994 Final Version** *Intuit*
2	--	**TaxCut Final Federal Edition** *Meca*
3	5	**WinCheckIt 2.0** *Touchstone Software*
4	6	**DOS 6.22 Upgrade** *Microsoft Corp.*
5	8	**WordPerfect 6.1 for Windows Upgrade** *Novell*
6	--	**Internet in a Box** *SPRY*
7	4	**Procomm Plus for Windows 2.0** *Datastorm*
8	1	**PerfectOffice 3.0 Upgrade** *Novell*
9	--	**Perform 1.0 for Windows** *Delrina Technology*
10	--	**Microsoft Windows 3.11** *Microsoft Corp.*

This list ranks PC business programs according to the total number of copies they shipped to over 12,000 stores and resellers in the week ending January 28, 1995. The list cannot be interpreted as a picture of the entire software market. Adapted from a compilation by Ingram Micro.

Can Videoconferencing See Eye to Eye?

WHEN IT COMES TO PERSONAL conferencing, Intel's Michael Glancy is one of the industry's foremost evangelists. Given half a chance, he'll gladly paint scenes of global workgroups that share live video, voice, text, and graphics. He'll talk about connecting people on a LAN videoconferencing system with people on an ISDN or on an analog phone line system, as well as integrating Windows, OS/2, Macintosh, and Unix users into a single conference. Most of all, he'll tell you about PCS (Personal Conferencing Specification, not to be confused with another PCS acronym for personal communications services), a new cross-platform communications standard that may soon make all of this possible.

Glancy chairs the Personal Conferencing Work Group (PCWG), the Intel-driven consortium of 150 computer, telecommunications, and teleconferencing vendors that ratified PCS, Version 1.0, last December. The group's mission is to develop cross-platform standards for all types of conferencing.

PCS 1.0 handles mixed audio/video/document conferencing through switched digital lines (such as ISDN or Switched 56), and data transfer over LANs. Version 2.0, due by the end of the year, will add multimedia capabilities to LAN-based meetings and define standards for network administration, LAN/WAN gateways, and videoconferencing over conventional analog phone lines. Analysts expect PCS-compliant Windows products on the market by the third quarter.

Despite the hoopla, not everyone shares enthusiasm for PCS. Boardroom-style group videoconferencing systems, which communicate over long-distance digital lines, use the International Telecommunications Union's (ITU) H.320 protocol. To ensure interoperability, many users would prefer a personal-conferencing spec akin to H.320.

Intel and the PCWG argue that cost-effective personal videoconferencing will arrive years before the ITU could complete work on a LAN-oriented H.320 variant. They also assert that PCS is designed for the telephone desktop, taking into account standards such as Microsoft's TAPI and Novell's TSAPI, Microsoft's DVI, and Intel's Indeo video codec.

It's too soon to predict whether H.320 or PCS will prevail, but in the short term vendors are straddling the fence. Compression Labs and VTEL—two of the biggest group-system manufacturers—are said to be developing dual-protocol systems, and a number of circuit manufacturers are preparing "transcoder" chips that will interconnect the two types of systems.—*Don Labriola*

Intelligent Agents Meet the Social Interface

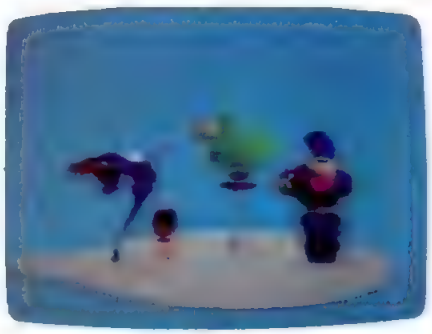
A NEW GENERATION OF INTELLIgent agents that automate and simplify software tasks is evolving. At the same time, it's unclear whether an intelligent agent should be a graphical character—such as the "guides" found in Microsoft Bob's "social interface"—or simply a set of scripted rules. Is an intelligent agent a character capable of assisting with tasks, such as Bob's Rover the dog, who can—through OLE—look up an address in Bob's Letter Writer? Or does a set of e-mail rules qualify as an intelligent agent?

Bill Fallon, director of marketing for AT&T's PersonalLink mail service, says true intelligent agents aren't defined by graphical representation at all, but by a key characteristic—mobility—that makes them able to perform unattended, complicated tasks across network services. Fallon says that the value of performing mobile, unattended tasks will be better understood later this year, when upcoming agents break through a long-standing limitation: the inability to move from place to place.

"Future agents—and General Magic has promising ones in the works—will be capable of going from service to service, on and off networks," says Fallon. The result is that several upcoming agents built with General Magic's Telescript agent-creation software will perform complex tasks. For example, an agent based on a script that consists of mail and network rules would let you leave a message for Alice in her mailbox, with a rule that the agent should check back in with the mail service at 10 o'clock to see if Alice has picked up the message. If she hasn't, the agent will look up her fax number and fax her the message.

General Magic is also focusing on several task-specific agents that make use of network services such as PersonalLink. Jim White, vice president of General Magic's Telescript division, is working on an agent called Night on the Town, which can perform several tasks across multiple services supported by PersonalLink.

By using Night on the Town, you could send an agent to purchase theater tickets, find a restaurant near the theater, and have flowers sent home before dinner. AT&T is building PersonalLink's network infrastructure in conjunction with electronic merchants—including Computer Express, 1-800-Flowers, and Tower Records. General Magic is working on another agent that will search electronic yellow pages to find the electronic merchant with the lowest price on, say, a camera. And the company will soon announce a series of front ends developed by third parties that use Telescript-built agents to scour SQL databases and on-line services.



Do characters like Peedy, the speech-recognizing parrot that Microsoft is positioning as the lead guide in future versions of Bob, represent the future of intelligent agents?

Alex Gruzman, director of business development at Sony's Personal Information Co., which sells the Magic Cap-based Magic Link personal digital assistant, says that "information-gathering from a variety of remote services is the next step for intelligent agents." He points out that these upcoming applications of intelligent agents all subscribe to the "send and forget" agent model. These "send and forget" agents are mobile and network-smart; once sent to perform a task, they can move from place to place until the task is done. He also points out that one must be very careful about representing agents with characters, which can potentially compromise a key part of a good interface: predictability.

According to David Thatcher, group product manager for Microsoft Bob, characters are essential. Peedy, an anthropomorphic 3-D rendered parrot positioned as the lead guide in the next version of Bob, will recognize speech and do text-to-speech synthesis. As Peedy's skills take shape, you'll be able to instruct it verbally to search The Microsoft Network for specific information. Or you might have it take dictation of a letter, find the right fax number, and fax the letter.

Future versions of Bob will follow the network-smart model for mobile agents pioneered by AT&T and General Magic. Microsoft is now soliciting mail and network service providers to function as back ends for advanced guide-based tasks.

—Sebastian Rupley

Briefs

CDPD IS ON THE MOVE. AFTER COUNTLESS delays, CDPD (Cellular Digital Packet Data) technology is finally headed for widespread national coverage. At the Cellular Telecommunications Industry Association trade show, plans were announced to network 20 new cities by the end of 1995's first quarter, including New York, Dallas, Philadelphia and Las Vegas.

WARP'S ON A ROLL. ACCORDING TO SALES information from Ingram Micro, OS/2 Warp was the best-selling software product for several weeks toward the end of '94, and was among the top ten earlier this year. IBM says it recently surpassed the one-million-copies-sold mark. It won't talk about the next version of Warp, but the product—nicknamed Warp 2—is believed to feature Windows 95 compatibility. Several software developers, including Computer Associates and Macromedia, have signed on to port products to Warp.

LET THE BEST OS WIN. APPLE AND SONY are backing different operating systems for their Newton and MagicLink PDAs, but Motorola—in a move that could be widely copied as PDA hardware reference designs improve—is taking the ecumenical approach. The company's new Envoy PDA (like Sony's MagicLink) is based on General Magic's MagicCap operating system, but the company's new Marco PDA is Newton-based.

THE WORLDWIDE SUPPLY OF MEMORY chips is expected to drop temporarily as a result of earthquake damage to memory chip fabrication plants in Kobe, Japan. Prices should remain stable, however.

—Sebastian Rupley

Photography by Thom O' Connor

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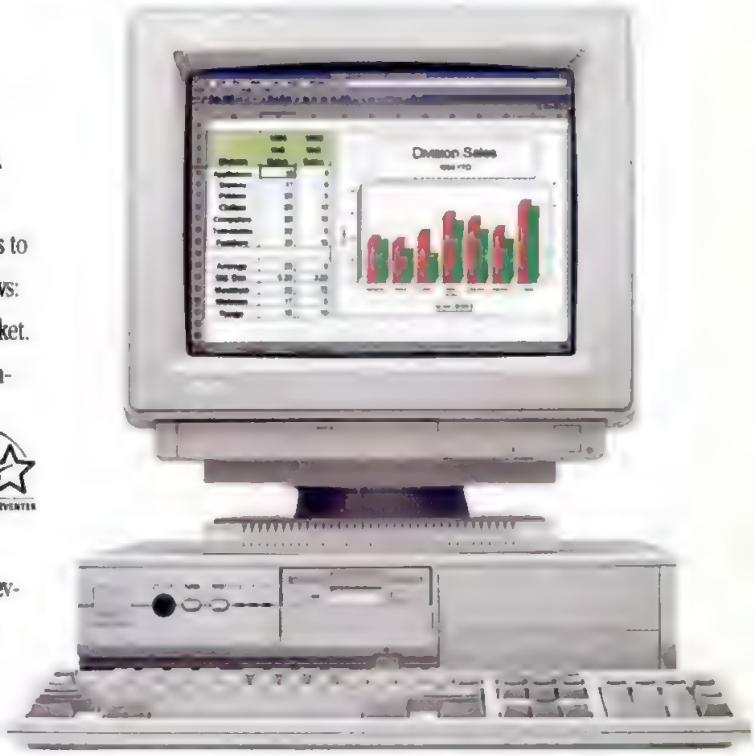

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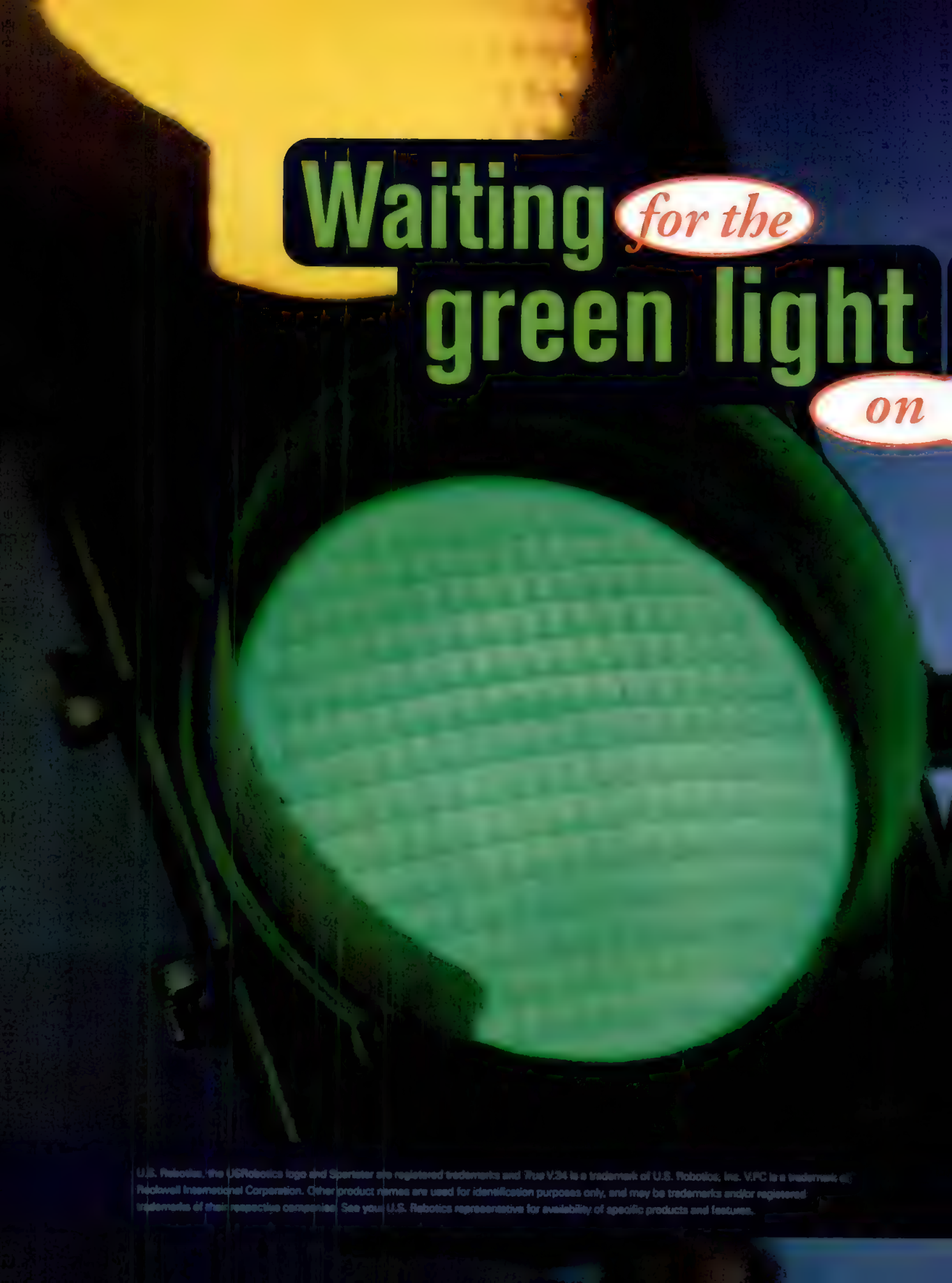

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First Looks

HANDS-ON REVIEWS OF NEW SHIPPING PRODUCTS

■ **Upgrade Processors**

Turn Your 486 PC into a Pentium...Sort Of

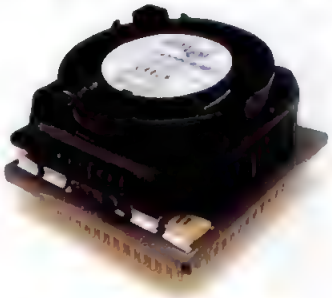
BY SEBASTIAN RUPLEY

Intel's Pentium OverDrive processor is great news for owners of low-end and some midrange 486 systems who are in search of a little extra processing power. Yet while the $449 chip nearly triples the computing power of a 25-MHz 486 PC, the OverDrive lags compared to a full Pentium PC.

Technically, the Pentium OverDrive processor is a mixed bag of old and new. Thanks to its superscalar architecture, fast floating-point unit, and branch prediction, the Pentium OverDrive chip is, as its name implies, a Pentium at heart. But to maintain compatibility, the OverDrive processor carries over some of the 486's architecture, including that chip's 32-bit bus (compared to the Pentium's 64-bit bus). The OverDrive does break new ground for Intel with its 32K internal cache, which is double that of Pentium's.

WILL IT WORK ON MY PC?

Replacing the system's CPU and running the configuration software took us less than 15 minutes—and many will find that removing the system's cover is the hardest part of the operation. The basic requirements to use the Pentium OverDrive chip are that your PC have either a 237- or 238-pin upgrade socket and that the system appear on Intel's list of upgradable systems. During our tests on a Dell 486/MX system, the Pentium OverDrive processor showed neither any trace of the Pentium's well-publicized floating-point flaw nor any compatibility problems with popular applications.



COOL RUNNING: *Intel's Pentium OverDrive processor won't melt down, thanks to a built-in fan and monitoring circuit.*

The 63-MHz Pentium OverDrive chip includes a cooling fan that dwarfs the actual processor chip. A software monitoring utility that is loaded during start-up keeps an eye on the CPU's temperature. Should the fan behave erratically or stop, a software notification is sent out

Continues on page 38

■ **Videoconferencing**

Video over Regular Phone Lines? Creative Labs Makes the Call

BY JOHN R. QUAIN

Videoconferencing typically means fussing with special digital phone lines, conducting negotiations with telephone companies, spending thousands of dollars, and enduring hours of frustrating installation headaches. Creative Labs is trying to redefine desktop videoconferencing by making it work over plain old telephone service (POTS) lines. The results are mixed: While the $1,599 ShareVision PC3000 system provides an acceptable picture, don't expect the smooth-flowing video available on more expensive digital phone systems.

Although its video quality is limited by the data bottleneck that comes with using an ordinary telephone connection, ShareVision's application sharing feature means that even if the video image isn't perfect, you can still get some work done.

The ShareVision package comes with an external 28.8-Kbps V.Fast modem (V.34 modems should be shipping by the time you read this), a small color video camera, a combination earpiece/microphone, Windows software, and a pair of expansion cards. The two cards—a 16-bit ISA Video Blaster RT300 and a 8-bit ISA ShareVision communications board—handle all the audio and video chores.

SIGHT AND SOUND

The Video Blaster card captures and compresses the PC's outgoing video signal and can handle three standard composite video inputs and one S-video input. Incoming video is decoded through software, relying on the PC's CPU, so having a high-performance system does help on the receiving end. The communications board adds sound to the picture and includes a high-speed serial port to give the 28.8-Kbps modem the necessary buffering.

ON THE AIR: *ShareVision's color television camera is small and unobtrusive.*

On the software side, the package boasts full application

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Apple MessagePad 120 39
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Pentium OverDrive

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and the chip is slowed to 25 MHz until things cool down.

As is true with all of Intel's OverDrive chips, the Pentium OverDrive gives the most dramatic boost to processor-intensive applications. On our PC Bench, Version 9.0, $CPUMark_{16}$ tests, the OverDrive chip increased processor power by 180 percent compared with the 486SX/25 base PC (see benchmark box) and nearly doubled processor performance when upgrading from a 486DX2/50.

The Pentium OverDrive processor's performance on our application-based Winstone 95 tests was less impressive. Our test system's Winstone 95 score doubled with the Pentium OverDrive processor, compared with the 486SX/25-based system. This places the OverDrive-equipped PC at approximately a 40 percent disadvantage compared with a typical 60-MHz Pentium system.

FASTER YET

Though the 63-MHz OverDrive chip will boost the performance of a 486DX/33 PC slightly, it is aimed primarily at 25-MHz and clock-doubled 50-MHz systems. Midyear, users of 33-MHz systems will get a similar performance boost from Intel's 83-MHz Pentium OverDrive chip. Future OverDrive processors are expected for systems powered by DX4 processors as well. What is not expected is an OverDrive processor to upgrade the many 16-MHz 486 systems that were sold early on in the 486 reign.

Priced at $449, the 63 MHz Pentium OverDrive processor upgrade gives PCs a substantial performance kick—particularly to 25-MHz machines. And in light of recent price declines in Pentium processors, the OverDrive upgrade's strongest competition may come, ironically, from a generation of sub-$2,000 Pentium systems that come complete with up-to-date hard disks, monitors, and graphics cards.

▶ **63-MHz Pentium OverDrive Processor.** List price: *$449.* Requires: *PC with either a 237- or 238-pin upgrade socket.* Intel Corp., *Santa Clara, CA; 800-538-3373, 503-629-7354; fax-back, 503-629-7576; fax, 503-690-8028.*

Circle 431 on reader service card

FIRST LOOKS PLUS

From March 20 through 24, you can go on-line to discuss Intel's new Pentium OverDrive processor with reviewer Sebastian Rupley and Jim Yasso, general manager, and Bob Bennett, marketing manager, of Intel's end user components division. Type GO EXEC at any CompuServe ! prompt.

BENCHMARK TESTS: INTEL'S OVERDRIVE PROCESSOR

With the 63-MHz Pentium OverDrive processor in place, our test PC was able to increase its Windows performance by roughly 100 percent and its processing power by 180 percent relative to its performance with a 486SX/25 chip. The gains were less impressive relative to 486DX2/50 performance.

We ran these tests on a Dell 486/MX with 12MB of RAM

■ **PDAs**

MessagePad 120: Closer, But Still Not Quite There

BY SEBASTIAN RUPLEY

After a disappointing start, Apple has refined the Newton's overall design, and upgraded its hardware and software. But the $599 MessagePad 120 still leaves you wishing for more.

The handheld personal digital assistant now has a removeable lid, a thinner glass panel that makes its reflective LCD much easier to read, and a relocated, higher-power Type II PCMCIA slot, which provides for extra storage or applications.

Powered by a 20-MHz ARM 610 RISC processor, the MessagePad 120 comes with 1MB of RAM for $599, or 2MB of RAM for $699. The 2MB model is the way to go, as the extra $100 buys you not only the additional RAM, but a 9,600-bps fax modem and a copy of Intuit's PocketQuicken.

HAND-OFF: *The Newton MessagePad 120 fits in the palm of your hand and features an easier-to-read screen.*

We got about 25 hours of stop and go computing out of the four included AA batteries—far short of the approximately 100 hours that the similar Casio Zoomer can run for. A rechargeable nickel cadmium battery pack costs $25; a lithium battery is included for backup, so you won't lose data when the cells are drained.

Using the unit's infrared transceiver, you can still wirelessly exchange information between two Newtons that are up to 3 feet apart. Disappointingly, this system is still not compliant with the IrDA standard, so you can't communicate with the growing number of IrDA-compatible notebooks and printers.

Newton has made at least as much progress on the software front. We were impressed with the Notions database, the Great Meetings scheduler, and the new FilePad. The best applications are not driven by handwriting recognition, but are form-based.

How accurate is the handwriting recognition? Not very. When we jotted down "get travel schedule," the MessagePad 120 interpreted this command as *aetwaud Sihdader,* and "call the IRS" became *cull theissr.* Apple's tips on how to improve recognition help a little, but there is still no provision for an add-on keyboard.

Despite better hardware and software, the MessagePad 120 faces stiff competition, especially from devices based on General Magic's MagicCap software, such as Sony's MagicLink and Motorola's Envoy.

Though the Newton's Assist feature can perform helpful tasks such as filling out a fax cover sheet, Sony's MagicLink—for one—goes further with intelligent agents. MagicLink uses agents based on the Telescript language to perform complex e-mail tasks and includes Palm Computing's very accurate Graffiti handwriting recognition engine. Graffiti is available as an option on the Newton, but be warned: You'll have to relearn the way you form letters for best results.

As improved as the MessagePad 120 is, there is still room for further development.

▶ **Apple MessagePad 120.** List price: *With 1MB RAM, $599; with 2MB RAM, $699.* Apple Computer Corp., *Cupertino, CA; 800-538-9696, 408-996-1010; fax, 408-974-9974.*

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ShareVision

CONTINUED FROM PAGE 37

sharing, as well as a whiteboard that enables you to scan in an image using a Twain-compatible device. You can add highlights and electronic notes and even zoom in on details. In addition, a snapshot utility lets you capture and send what's on-screen.

Getting all this up and running is relatively simple. The installation software is clear and concise and even allows you to change I/O addresses without throwing DIP switches or pulling jumper brackets. The IRQ address still needs to be set via jumper switches, however. If you've ever installed a sound board or a SCSI adapter, you'll have an easier time with ShareVision.

Making a video call is as easy as making a phone call. Just dial the number on ShareVision's on-screen keypad. The other party can answer the call using a regular telephone and then switch over to their own ShareVision system. There's no need for a separate phone call to set up the conference in advance. An address book is included, although it isn't quite as extensive as those found in ISDN-based systems like Intel's ProShare or AT&T's Vistium.

SLOW MOTION VIDEO

Once you're connected, the first thing you'll notice is that the ShareVision system, like other PC-based videoconferencing systems, doesn't deliver full-screen, full-motion video. The images are fuzzy and window sizes are restricted to images between 96 by 80 pixels and 160 by 120 pixels. Furthermore, while a standard NTSC television broadcast contains about 30 images or frames per second (fps), Creative Labs' product can only manage to pump out about 5 to 10 fps.

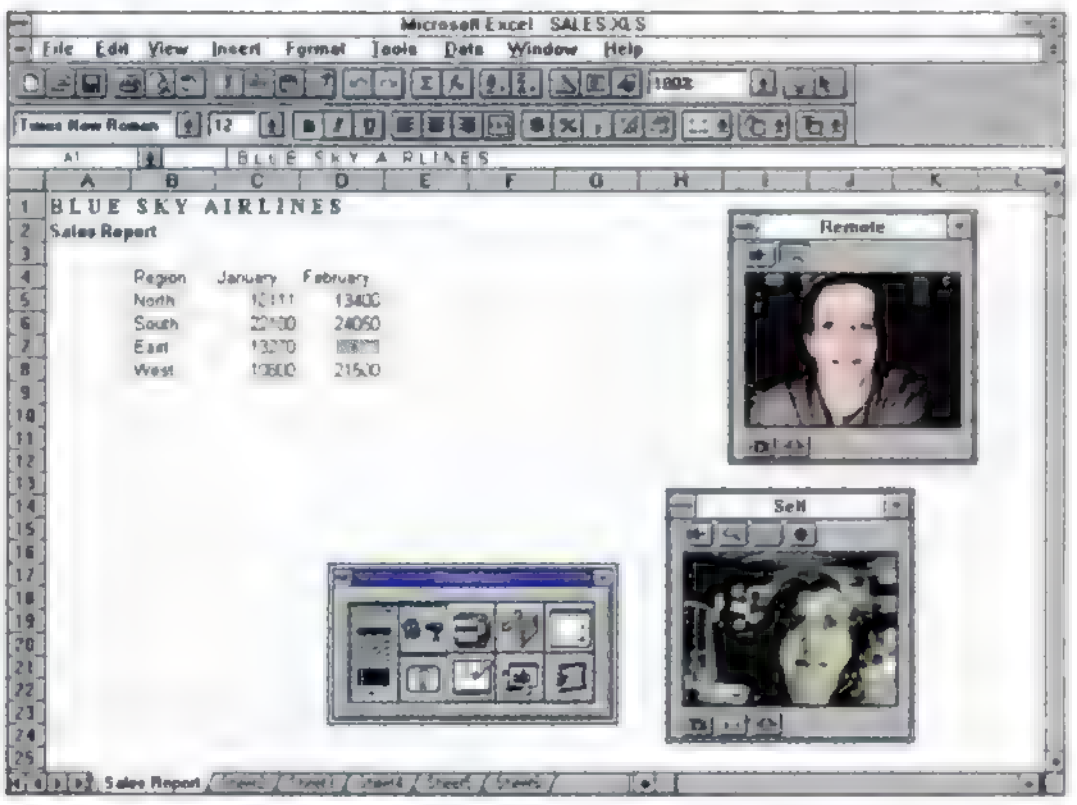
Given these limitations, ShareVision's video quality was tolerable on the pair of 66-MHz 486DX2 PCs that we used for our evaluation. The low frame rate leads to robotic gesticulations and out-of-sync audio that can make people seem as if they're trapped in a slapstick comedy. Yet once you become accustomed to the image delay, it becomes as comfortable (or uncomfortable) as using a standard speakerphone.

To get the best possible picture, you can adjust brightness and contrast through ShareVision's software. You can also sacrifice image detail to increase the number of frames transmitted per second, resulting in a smoother—albeit a fuzzier—picture.

The ShareVision system has additional limitations. The most onerous is that the color quality of the image depends on your system's video adapter. In our tests, we found that the best results required 24-bit color video in Windows. If you're limited to a 256 color pallette, the picture will look like a posterized rock video.

In order to get the best frame rate and the most realistic motion, you need a reliable 28.8-Kbps telephone connection. If the data-transfer rate drops to less than that, so will the frame rate. In our tests with local and long distance calls, we found that phone line quality varied greatly. The best we could hope for was a reliable 21.6-Kbps connection. Even at that rate, the vagaries of analog phone lines often caused calls to be interrupted or connections to be severed.

To squeeze all the information onto a standard phone line, Creative Labs uses a proprietary codec called VATP (Vector Adaptive Transform Processing), which dynamically assigns the available bandwidth by giving priority to audio, then to data, and finally to video. Consequently, the more you talk, the slower the data transmissions will be, and the goofier you'll appear in the on-screen window. Furthermore, if you decide to share a document, expect the system to be overwhelmed, freezing the video stream for a short time.



HEAR ME, SEE ME: *It isn't full-motion video, but ShareVision still lets you see who you're talking to.*

WORK WITH ME

On a positive note, the irregular video quality is acceptable if your focus is more on information sharing than interpreting body language or facial gestures. As each user moves his or her cursor around the window, ShareVision's application sharing transfers control back and forth while an on-screen light indicates who is in command. You can lock out the other person if you want or let them edit with you.

The main advantage that the ShareVision system offers is that it doesn't require a special digitally switched Integrated Services Digital Network (ISDN) line, which is required for Intel's ProShare or AT&T's Vistium. ISDN service—when it's available—costs $40 a month or more (plus long distance charges, of course), requires separate installation, and can be difficult to set up and get running.

On the other hand, the image quality of ShareVision conferences are limited by a POTS bandwidth of 28.8 Kbps—versus ISDN's 128-Kbps bandwidth.

DOES NOT TRANSLATE

And then there's ShareVision's compatibility problem. Whereas ISDN systems are offering a growing degree of interoperability between systems using the International Telecommunications Union's H.320 standard, there are no POTS videoconferencing standards. The ITU is working on a POTS specification called H.32P, but it probably won't be completed until 1996. In the meantime, if you want to start videoconferencing over regular phone lines with ShareVision, you can make the connection only with someone who happens to have an identical setup.

All its shortcomings aside, the ShareVision PC3000 package offers more than just videoconferencing—and it's still cheaper than the price of a couple of round-trip coast-to-coast airline tickets. For those who need to work closely with distant counterparts, this may be an inexpensive way to reach out and *almost* touch someone.

► **ShareVision PC3000, Version 1.1.** List price: *$1,599.* Requires: *8MB RAM, 6MB hard disk space, one 16-bit ISA slot, one 8-bit ISA slot, Microsoft Windows 3.1 or later, standard analog telephone line.* Creative Labs Inc., *Milpitas, CA; 800-998-1000, 408-428-6600; fax, 408-428-9871.*

Circle 420 on reader service card

Process Management

Process Charter Models the Real World

BY CRAIG STINSON

With its $595 Process Charter for Windows, Scitor Corp. integrates a presentation-quality flowchart generator with excellent process-modeling and simulation tools that, by themselves, have typically carried five-or six-figure price tags. This affordable alternative can provide invaluable support to companies engaged in business reengineering or that are simply playing out what-if production or staffing scenarios.

The analysis starts with a flowchart. Using standard symbols, lines, and connectors, you diagram the movement of resources. Like ABC FlowCharter and Visio, Process Charter provides the expected array of symbol palettes, intelligent lines that snap to the symbols' connection points, and text that can float or attach to lines or symbols. All graphical elements are customizable, and modified shapes can be added to built-in palettes. In addition, you can save these template files to ensure consistency among projects.

Process Charter breathes life into the flowchart by letting you enumerate resources, identify their costs and availabilities, and assign them to various processing steps in the model. In Activity dialog boxes, you spell out the characteristics of each step in your process, such as specifying time constraints.

At any process node, flow can be governed by probabilities, by priorities, by a combination of probability and priority, or by longest or shortest queue size. When modeling movement of customers, for example, you would direct flow toward the shortest queue, but when modeling the application of labor to alleviate bottlenecks, you would head for the longest queue.

With the model in place, click on the Run icon to start the simulation, which can be stepped in intervals if you choose. Process Charter's animation uses colors in order to distinguish running activities from idle ones and to show bottlenecks.

Process Charter presents results in spreadsheets and in graphs that can be used to determine activity-based costs and underused resources, as well as to generate total-effort and total-cost figures. But the beauty of Process Charter is the feedback it provides when you change a parameter, add a contingency, or combine steps and compare the results with previous simulations.

Process Charter is a breakthrough program that can realistically model the complexity of the real world.

SEE HOW IT RUNS: *Process Charter goes beyond representing flow to simulating operation.*

▶ **Process Charter for Windows.** List price: *$595.* Requires: *4MB RAM (8MB recommended), 8MB hard disk space, Microsoft Windows 3.1 or later.* Scitor Corp., *Foster City, CA; 800-549-9876, 415-462-4200; fax, 415-462-4201.*

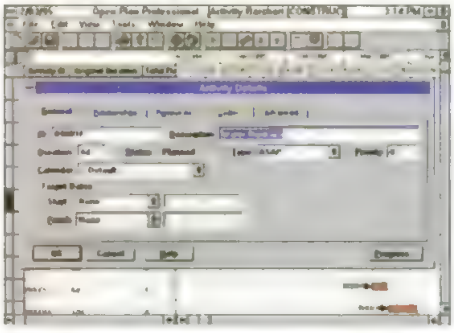
Circle 421 on reader service card

Project Management

Open Plan Professional Simplifies Managing a Project

BY BARRY BRENESAL

Welcom Software's Open Plan Professional 1.0 stands out from the crowd of project management packages by emphasizing ease of use above all else. This $6,000 program succeeds at making project management more accessible, but it lacks the depth and flexibility of other project management programs.



QUICK STUDY: *Activity data is provided for quick access in tabbed dialog boxes.*

The secret of Open Plan's usability is its interface. When you start the program, you're greeted with an inviting main screen that contains the program's notebook. Other project managers start up with a combination bar-chart/spreadsheet. Open Plan stores all projects, data, views, and view templates under specific icons in a single file cabinet. This approach is fine for projects of small scope, but it's of little help when manipulating multiple projects or dozens of views.

Aside from the table-of-contents page (which supplies general project information) everything in Open Plan is customizable—from the tabs that let you reorganize contents to the icons used to display and arrange data. We added the 1994 California sales data to a marketing project by dragging the California resource data icon from the file cabinet into a project notebook. This was simpler than the cumbersome import/export or cut-and-paste methods of other project managers.

Open Plan shares many features with field-leading Primavera Project Planner. While both let you define resource priority rules, quickly identify resource bottlenecks using easy-to-follow 3D graphs, offer sophisticated cost control with inflation profiles, and include strong system security provisions, Open Plan goes its own way. It provides pop-up Clip Notes—which describe how to build a plan with clearly written instructions—that appear whenever you open a blank view. But the Clip Notes pale compared with CA-SuperProject's PM Assistant or Microsoft Project's Wizards, which automate procedures.

More problematic is the lack of a true reporting facility. You're limited to printing the program's views, although you can preview and zoom in or out. Project Planner's ReportSmith lets you define, customize and save any number of report templates.

Open Plan presents an innovative interface, but for now must be considered a project manager under construction.

▶ **Open Plan Professional, Version 1.0.** List price: *$6,000.* Requires: *4MB RAM, 20MB hard disk space, Microsoft Windows 3.1 or later.* Welcom Software Technology, *Houston, TX. 800-274-4978, 713-558-0514; fax, 713-584-7828.*

Circle 422 on reader service card

New Close-Up Offers Fastest Remote Windows Speed

Fastest Modem Communications

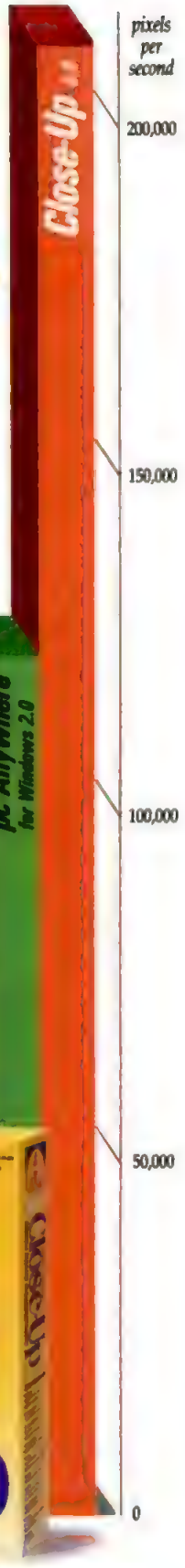
Now Close-Up, two-time winner of PC Magazine "Editors' Choice" award for remote communications software, has a brand new version that lets you view & control other PCs *by modem* – just as if you were there!

WinBench™ 95 Ver 1.0 by Ziff-Davis Labs Tests Remote Windows™ Speed

The graph on the right shows the speed of the three leading remote control programs when transferring Windows screens. As you can see, Close-Up handles more pixels faster, meaning you spend less time waiting for Windows screens to transfer.

WinBench scores (average of 10 runs):

Close-Up	*209,270*
pcAnywhere	*122,600*
Reachout	*101,900*



"Version 5.0 Close-Up was fast, but Version 6.0 has even better Windows performance and added features to keep it ahead of the pack."

– PC Magazine, July 1994

WINDOWS & DOS

Close-Up saves time & money by allowing you to connect between PCs running DOS or Windows, eliminating the need to switch between products when connecting to different PCs.

Why Is Close-Up So Fast?

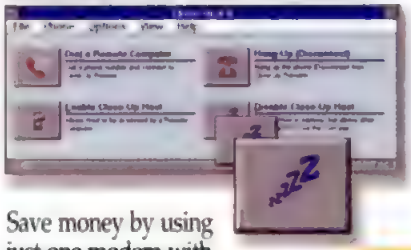
Close-Up learns as it works. It uses AI (Artificial Intelligence) to compress all Windows video function calls. That's why Close-Up does so well in Windows Benchmark tests (see WinBench 95 chart).

Close-Up uses its revolutionary Photographic Memory™ so that once Close-Up has seen all or part of a Windows screen, it's memorized. Then as screens change, Close-Up only transmits new unmemorized data. Incredibly, with this technology ***Close-Up gets faster & faster the longer you use it.***

Non-Intrusive Technology

Unlike other remotes, Close-Up's installation does not modify any of your sensitive Windows files, including the SYSTEM.INI and WIN.INI files, allowing Close-Up and your PC to run at optimal levels.

Use Close-Up and Your Fax Software on One Modem



Save money by using just one modem with Close-Up *and* your fax software. Simply click the Close-Up sleep icon. What could be easier!

Expert System Makes Communications Easy

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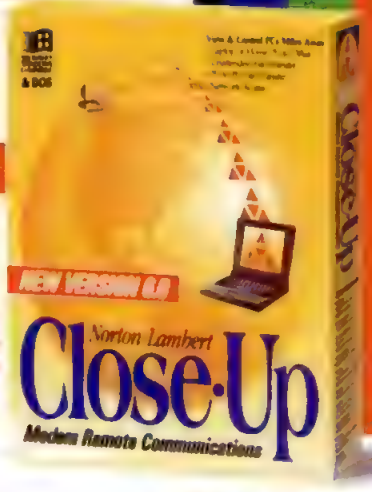

We invite you to reproduce this test. Modems: Hayes OPTIMA 288 V.FC. Computer: (Host) Gateway, (Remote) Micron, Pentiums 90Mhz, 32MB RAM, 128KB RAM cache, 500MB HD, IDE controller, no hardware disk cache. Video: (Host) STB Lightspeed 1MB VRAM, (Remote) Diamond Stealth 64 2MB VRAM. 800 x 600 pixels, 16 colors. SuperVGA.DRV 11/1/93, 75 Hz. MS-DOS 6.22, SMARTDRV 2MB cache. WinBench 95 is available on ZiffNet via CompuServe. All products are shipping versions. Test performed without verification by Ziff. WinBench trademark of Ziff-Davis Publishing Co. Windows trademark of Microsoft Corp.
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October 1994 Close-Up 6.0 · November 1993 Close-Up 5.0 · January 11 1993 Close-Up 4.0 · February 25 1992 Close-Up 4.0 · February 1992 Close-Up 4.0 · January 14 1992 Close-Up 4.0 · November 18, 1991 Close-Up 4.0 · March 1991 Close-Up/LAN 2.0 · January 16, 1990 Close-Up/LAN 2.0 · Close-Up 3.0A · October 31 1989 Close-Up/LAN 2.0 · April 1989 Close-Up 3.0A · February 1989 Close-Up 3.0A · October 1988 Close-Up 3.0A

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CIRCLE 346 ON READER SERVICE CARD

Modems

Fax, Phone, Sound, and Data on a Card

BY ALFRED POOR

A flock of multifunction cards that combine modem functions with audio are set to fill the market. Two of the first to combine fax, phone, sound, and data capabilities are the $379 Media Manager from ObJIX Multimedia and the $199 SoundExpression 14.4VSp from Boca Research.

While the two products have similar functions, they take different routes to deliver them and vary in cost.

MEDIA MANAGER: BRAINS ON BOARD

The Media Manager relies on DSP (digital signal processor) technology to perform its card trick. Based on IBM's MWave technology, the Media Manager can configure the DSP on the fly to operate as a 14.4-Kbps modem or Sound Blaster–compatible audio card. This also means that you will be able to upgrade the card's features through software; the upgrade to a 28.8-Kbps modem comes on a floppy disk.

The Media Manager can pull double duty, letting you use the sound card at the same time as the phone or the fax. You cannot, however, use the phone or fax at the same time as the modem. The evaluation unit we used required that we load and unload the various programs as needed. The problem is that you have to unload the telephony software if you want to use the modem, then reload the software when it is time to send a fax or use the phone again. According to ObJIX, revised software is under development to fix this limitation.

Installation of the card is surprisingly easy, especially when compared with the tribulations of adding a typical internal fax modem and a separate sound card. The Media Manager card requires a COM port assignment and an IRQ setting for the fax/modem, an IRQ setting for the Sound Blaster audio portion, and a third IRQ setting for the board itself. The card's automatic configuration took just a few minutes and worked without a hitch. We were up and running in a matter of minutes.

The two-thirds-length card comes with two phone jacks, a DIN connector, and a D-connector for a Plustek scanner. A pigtail adapter plugs into the DIN connector, with jacks for stereo line in and line out, as well as a jack for a microphone; a clip-on microphone is included. A game port connector comes on its own separate edge bracket, and the board also includes connectors for a Sony CD-ROM drive.

The package comes with Windows applications that provide digitized sound support, as well as fax, data, and phone management—but they're all a bit rough around the edges. The software is fussy about the sequence in which you open the different modules; the phone log is cumbersome to use and could be formatted to work more efficiently; the speakerphone does not work as well as a dedicated telephone and does not support full duplex communication. This means that the two participants of a call cannot speak at the same time.

The biggest snag we encountered during testing was found within the sound portion of the card: It operates as a virtual device and is available only to DOS programs that run in a DOS window. A separate DOS TSR utility is under development, according to ObJIX.

A fine-tuning of the software portion of the product will likely make the Media Manager a very attractive way to add a lot of features to a personal computer in one quick step.

SOUNDEXPRESSION: BARGAIN BOARD

The SoundExpression 14.4VSp from Boca Research takes a different approach. Rather than work with DSP technology, it relies on tried-and-true discrete components for its different functions. In a very real sense, the SoundExpression is two boards in one.

This approach has two big payoffs: You don't have to shut down one function in order to use another and, at $199, the card is priced on a par with other 14.4-Kbps modems.

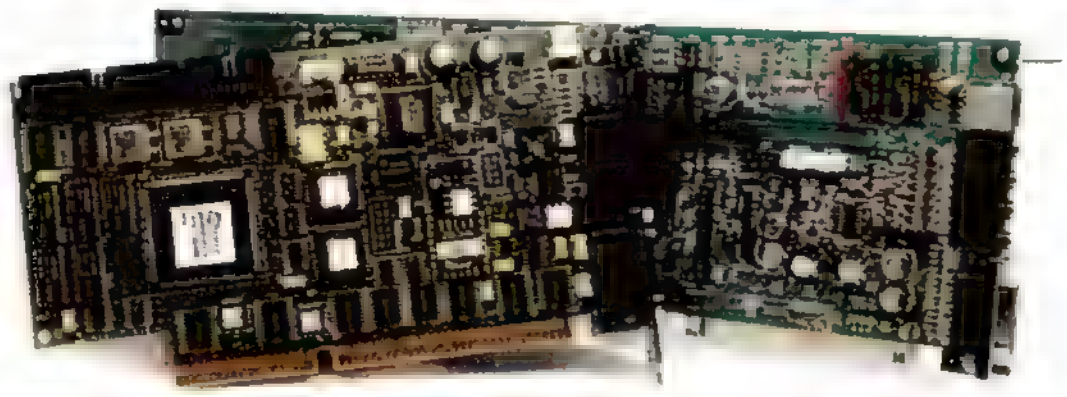
The full-length card includes Sound Blaster and Windows Sound System compatibility, MIDI capability, voice-mail (with up to 1,000 mailboxes), call-forwarding and paging, fax and data transmission, and telephone management (including a speakerphone that, like the Media Manager, is not full duplex).

The SoundExpression card comes with a full complement of connections, including a phone jack with a Y-splitter; stereo line in and line out, microphone and stereo speaker jacks, and a game port. The card also has data and audio connections for Sony, Mitsumi, and Panasonic proprietary CD-ROM connections, as well as an IDE connector.

The Sound Expression's installation program inspects your system, but stops short of automatic configuration, recommending a configuration instead. There are jumpers for the COM port assignment, but the rest of the card is configured through software.

The included Windows software is powerful and easy to use. The FaxWorks program from SofNet has some noteworthy features, including the ability to anti-alias incoming fax images. This useful function improved on-screen legibility. You can even use the software to screen incoming calls and set up a 10-document fax-on-demand system.

While it is not as close to the cutting edge as the ObJIX Media Manager, the SoundExpression board makes it easy and affordable to add telephony and sound in a single slot.



DOUBLE YOUR FUN: *The Media Manager (left) uses DSP technology to combine the functions of a modem and a sound card, while the SoundExpression (right) builds two discrete cards into one.*

► **Media Manager.** List price: *$379.* Requires: *4MB RAM, 6MB hard disk space, ISA slot, Microsoft Windows 3.1 or later.* ObJIX Multimedia Corp., *Waltham, MA; 800-854-6211, 617-466-8720; fax, 617-466-8722.*

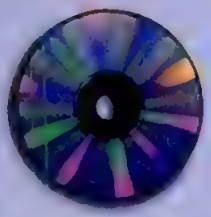
Circle 418 on reader service card

► **SoundExpression 14.4VSp.** List price: *$199.* Requires: *4MB RAM, 15MB hard disk space, ISA slot, Microsoft Windows 3.1 or later.* Boca Research Inc., *Boca Raton, FL; 407-997-6227; fax, 407-997-0918.*

Circle 419 on reader service card

BACKUP ON CD!

Recordable CD Backup System



TAPE IS OUT.

- Tape is slow
- No random access
- One-year shelf life
- Too many different formats
- Reliable?

OPTICAL IS IN.

- Recordable CD is fast
- Random access
- Five-year shelf life
- CD-ROM standard format
- Very reliable

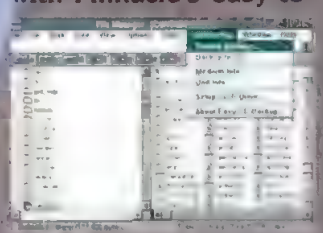
The CD has replaced the tape cassette in the music industry. And Recordable CDs are well on their way to replacing tape in the computer industry.

Introducing the new **Pinnacle RCD-1000™** - the best way to backup your data. Our Recordable CD System comes complete with backup software for **$1995**. Each Recordable CD holds up to 680 Megabytes of fast random access data. RCD media is reliable with a five-year shelf life guaranteed. And inexpensive, only **$29** per disk or **4 cents** per Megabyte. The Pinnacle RCD-1000™ is ideal for data archival, as well as creating and testing multimedia titles, even making your own music CD of custom tunes. The RCD is the best way to backup data since RCD media can be played back on most CD-ROM drives.

The new Pinnacle RCD-1000™ is a **double speed** multisession recorder and player. It supports ISO 9660, CD-XA, CDI and CD Red Book audio recording standards. The RCD-1000™ is equipped with a big 1 MB cache buffer that will ensure compatibility with most hard disk drive systems. Available in internal or external versions.

Pinnacle RCD-1000™

The RCD-1000™ system comes complete with Pinnacle's easy-to-use software program and **backup utility** for Windows. Simply drag and drop files from your File Manager application to your RCD application window and in minutes you've mastered your own compact disc - from data backups to new information creations.



Windows RCD Backup Utility

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Windows Graphics

HiJaak Graphics Suite: An All-in-One Image Toolkit

BY J.W. OLSEN

Inset's $99 HiJaak Graphics Suite for Windows, Version 3.0, surpasses the competition, delivering a complete workspace for raster and vector graphics, a handy vehicle for importing images into Windows applications, and just enough multimedia support to get things started.

CONVERT-A-MATIC: *Thanks to IGOR technology, HiJaak PRO converts from bitmap images to vector formats.*

FLEXIBLE INSTALLATION

Composed of five modules, HiJaak comes on both floppy disks and a CD-ROM, which allows occasional users to run the program directly from the CD-ROM and trade performance for hard disk space. This approach reduces the hard disk footprint to about 1MB, compared to 40MB for the full installation. However, initial copies of the CD-ROM require Version 2.23 or later of MSCDEX.EXE for CD-ROM installation. In addition, we encountered an unrecoverable error when we chose the custom install option. Inset is pursuing both of these problems.

FIRST LOOKS PLUS

From March 20 to 24, you can go online to download an evaluation version of HiJaak's Graphics Suite or to discuss the product with Inset Systems vice president Maurice Hamoy and reviewer J.W. Olsen. Type GO EXEC at any CompuServe ! prompt.

Of the suite's five components, the best known is an improved HiJaak PRO for Windows, which captures, converts, and enhances images. HiJaak PRO extends its lead over alternatives by adding support for .CDR, .RLC, Adobe Illustrator .EPS, and WordPerfect Graphics WPG2 formats. While continuing to capture Windows and DOS screens and perform conversions between just about any file format, HiJaak PRO now converts from raster to vector formats by exploiting Inset's sophisticated IGOR (Intelligent Graphics Object Recognition) technology. IGOR is surprisingly fast and supports both centerline and outline tracing.

Two other HiJaak modules come from other software firms and have been integrated well. Based on Gold Disk's Professional Draw, the 15 drawing tools in HiJaak's Draw module work on an unlimited number of layers to create or edit vector files. Color palettes support CMYK, HSB, PMS, and RGB color models. While you can wrap text around irregular-shaped objects or within shapes and print color separations, Draw allows only one level of undo.

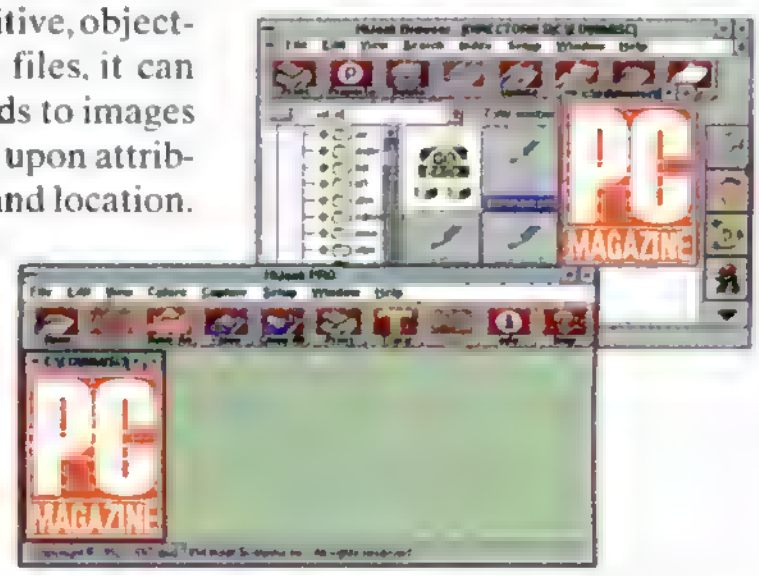
TouchUp is essentially Media Cybernetic's HALO Desktop Imager, minus the screen capture and gallery features. The best part is TouchUp's convenient desktop tools, which include slide controls for brightness, contrast, and gamma, as well as buttons for frame, pan, and zoom.

CENTER OF ATTENTION

The suite's organizational focus is the HiJaak Browser, which helps manage and search for graphics files. Browser features easy-to-reach icons at the bottom of the screen for each of the suite's major elements; it also provides an all-purpose file manager and lets you create catalogs, view individual images, and print thumbnails.

You can load graphics files into HiJaak PRO, Draw, and TouchUp simply by dragging an image's thumbnail onto program icons on Browser's desktop. We found that Browser not only provides intuitive, object-oriented access to files, it can also assign keywords to images and find files based upon attributes such as name and location.

In an addition that points HiJaak towards multimedia, Browser can now play .WAV, MIDI, .AVI sound, and .FLI and QuickTime animation files. While this extension is useful, it can be frustrating because you can't do any editing on these files.



EASY DOES IT: *Moving an image from HiJaak Browser into other suite applications is as easy as dragging file thumbnails onto app icons within Browser.*

The fifth module is HiJaak Smuggler, which lurks in the background, attaching itself to active applications that support pasting graphics from the Windows Clipboard. Smuggler can import any image HiJaak supports without leaving your app. Smuggler also makes it possible to incorporate graphics into apps that don't support OLE, or, conversely, when OLE isn't desired. HiJaak PRO is an OLE 1.0 server.

In theory, you can access Smuggler by clicking the icon it places on your app's title bar or via Smuggler's hotkey. Unfortunately, we were unable to invoke Smuggler from the icon under any test configuration involving a Cirrus Logic–based video subsystem.

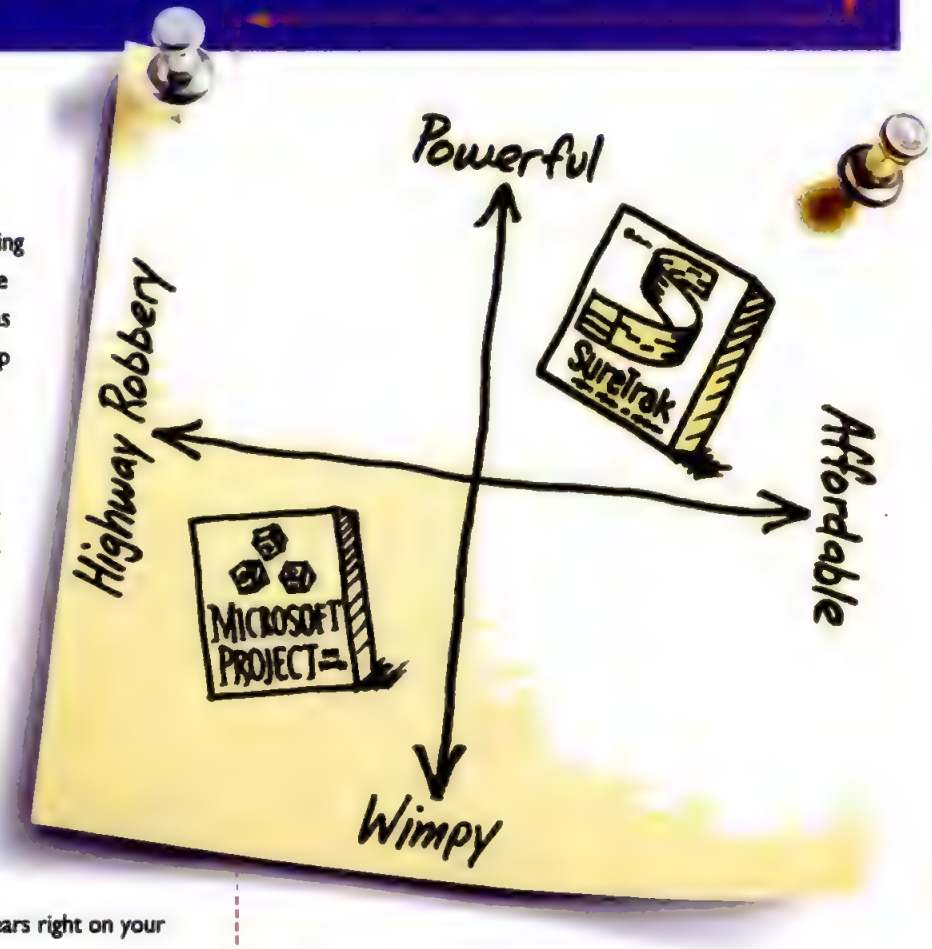
An added bonus is the inclusion of the Pantone Matching System (PMS). While it won't solve all your color-matching woes, it will reduce expensive trial-and-error printing.

HiJaak Graphics Suite for Windows surpasses both LEAD Technologies LeadView 3.0 for Windows and Ulead Systems' ImagePals 2 in scope, depth of editing tools, and integration. For a complete graphics toolkit, you'll be hard pressed to find this much power at any price, let alone for $100.

► **HiJaak Graphics Suite for Windows, Version 3.0.** Estimated street price: *$99; upgrade from HiJaak PRO 2.0, $49.99 (CD-ROM), $59.99 (floppy disk).* Requires: *4MB RAM, 40MB hard disk space for full installation or 1MB minimum from CD-ROM, Microsoft Windows 3.1 or later.* Inset Systems Inc., *Brookfield, CT. 800-374-6738, 203-740-2400; fax, 203-775-5634.*

Circle 415 on reader service card

Everything you need to know about project management software.



You're scrolling through screens. Shuffling cue cards. Wishing Microsoft Project had the power to organize by something as simple as who's responsible for what. But don't give up on project management software. Just think SureTrak Project Manager® for Windows.™

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CIRCLE 148 ON READER SERVICE CARD

Accounting

DacEasy: Full Contact Accounting

BY KATHY YAKAL

Because it includes many of the features that are found in traditional contact managers, DacEasy Accounting for Windows 2.0 has been transformed into a hybrid "contact accounting" package that can bring you closer to your customers and suppliers. The $149.95 program excels at promoting communications yet is not a formidable rival for low-end accounting packages such as Peachtree and QuickBooks.

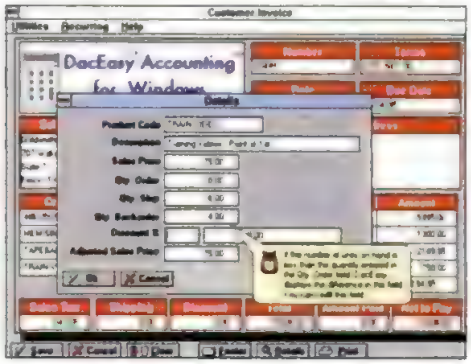
The new contact features enhance the program, but the emphasis is still on accounting. For example, you can auto-dial and time phone calls for easy billing, take notes on conversations, and schedule callback reminders. A link to Microsoft Write lets you do mail-merges, and a link to WinFax Pro enables you to fax documents. DacEasy's Personal Assistant guides you through the setup process with a boilerplate checklist; it then stands ready to help with daily to-do lists. Dated reminders appear every time you start the program, although you can't set alarms for specific times during the day.

While you can import financial data in Quicken (.QIF) and Timeslips formats, you can't use data from DacEasy Accounting for DOS. And we were unable to import a .QIF file from Quicken 4.0 for Windows (DacEasy will address this problem in a maintenance release).

With its sub-icons and lookup lists, DacEasy makes entering records and transactions easy. The new memorized transactions feature lets you modify an existing procedure or form to create a new transaction.

DacEasy's framework is comprehensive, integrating General Ledger, Accounts Receivable, Accounts Payable, Inventory, and Payroll modules. The program comes with 11 predefined Charts of Accounts. DacEasy adheres to accounting standards and provides an audit trail, offering options for error correction that should please both accountants and bookkeeping novices. The program's intuitive navigational system and straightforward menus are supplemented by a superb interactive tutorial, which requires 13MB of hard disk space. Also on hand to provide help is the DacAdvisor, an owl that pops up on the screen with useful explanatory balloons that describe the different program icons and operations.

With shortcomings such as its limited import and export abilities, DacEasy falls behind Peachtree and QuickBooks. But in terms of sheer accounting and contact management abilities, it often matches—and sometimes exceeds—its competitors.



UP AND RUNNING: *The DacAdvisor's explanatory balloons make DacEasy easy to learn.*

▶ **DacEasy Accounting for Windows, Version 2.0.** List price: *$149.95.* Requires: *4MB RAM, 20MB hard disk space (with tutorial), modem (for phone dialer), Microsoft Windows 3.1 or later.* DacEasy Inc., *Dallas, TX; 800-322-3279, 214-248-0305; fax, 214-713-6331.*

Circle 417 on reader service card

Communications

RhinoCom: Basic OS/2 Communications

BY KEVIN REICHARD

Best suited for entry-level users, RhinoCom 1.0, from Rhintek, is an easy way for OS/2 users to log on to a variety of on-line services and electronic bulletin boards. The $199 RhinoCom package focuses on ease of use and integration within the OS/2 Presentation Manager environment—which is likely to attract novices but turn off experienced OS/2 users.

During installation, RhinoCom interrogates your PC's serial ports and attempts to identify your modem. While not 100 percent accurate (RhinoCom failed to identify a U.S. Robotics Sportster modem), this modem detection system worked for several different models.

RhinoCom divides the communications process into two separate areas: dialing directories (dubbed the Rhinodex) and a terminal area. You can attach session configurations and telephone numbers for the various on-line services and BBSs you use to icons that can then be organized in the Rhinodex or dragged to the OS/2 desktop. This can be a real time-saver: To start a session, all you have to do is double-click on the icon (instead of loading RhinoCom and searching through the index for the on-line service you want).

MAIL'S IN: *RhinoCom can download MCI Mail messages, but you'll have to configure the program yourself.*

Support for existing on-line services is mixed. There's a useful script for CompuServe, but other text-based on-line services (such as Delphi, GEnie, and MCI Mail) are not preconfigured. Curiously, CompuServe is represented with a log-on script, but there's no support for the CompuServe B protocol.

An advanced user may be better off looking at another OS/2 communications package, such as TalkThru for OS/2, which surpasses RhinoCom by including a host mode and support for the Kermit protocol. In addition, RhinoCom relies on the built-in OS/2 REXX scripting language but offers neither documentation nor on-line help. And without a mechanism for RhinoCom to "learn" a log-on sequence, the user is faced with the daunting chore of adapting a current REXX script or writing one from scratch.

More experienced OS/2 users will probably want to sacrifice ease of use for a more powerful communications package. RhinoCom, however, may find a niche for itself as more and more novice computer users try OS/2 Warp.

▶ **RhinoCom, Version 1.0.** List price: *$199.* Requires: *4MB of RAM, 5MB hard disk space, OS/2 2.0 or later.* Rhintek Inc., *Columbia, MD; 800-234-4546, 410-730-2575; fax, 410-730-5960.*

Circle 416 on reader service card

Internet Access

Pipeline: Easy-to-Read Internet Roadmap

BY RICK AYRE

The Pipeline, Editors' Choice winner in our story on Internet service providers (October 11, 1994), expands coverage with its Pipeline Internaut 2.07 upgrade but still emphasizes ease of use. This free software package features improved e-mail and newsreader modules and adds a Web browser for trawling the Internet.

Internaut is still one of the easiest routes to the Internet: Everything is included, even the connection phone numbers. About the only thing you need to know is what port your modem is on. The software opens an account for you, and you just click on your destination from the Internet menu.

Though Prodigy offers similar Internet access (America Online and CompuServe aren't far behind), Internaut always keeps the Internet in a top-level menu. You also don't have to know which jump word the service uses to gain Internet access.

Yet for all its ease and Internet focus, Internaut could be better. The e-mail and news groups are easier to customize and use, but Internaut is not a standard Windows program, so it may seem awkward. Furthermore, there is no Windows menu item that shows a list of open windows—particularly troublesome because Internaut opens window after window.

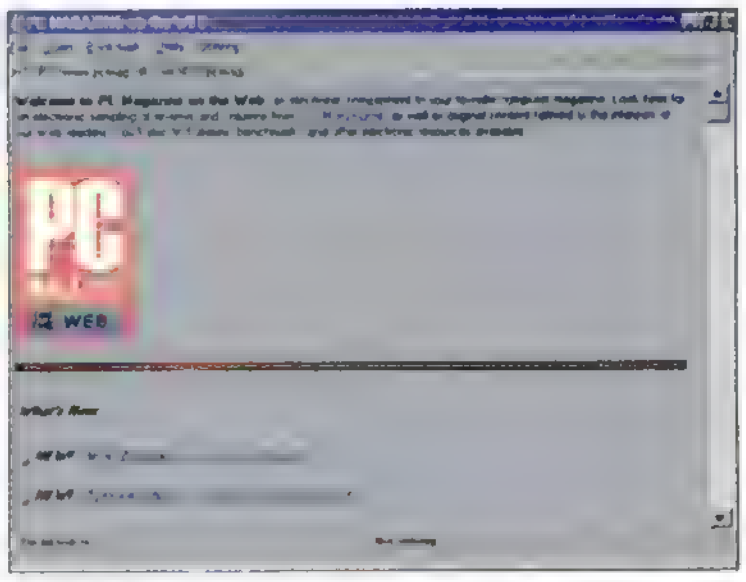
The program's Web browser is great for exploring the Internet but does not support authentication (a requirement for some secure Web servers) and is not as complete as Netscape, Spyglass, or AIR Mosaic.

The Pipeline has a flexible pricing structure: $20 for 20 hours of access per month, or $35 monthly for unlimited usage. That's if you live in the New York City area. Other areas can connect via a packet network through local phone numbers. The program supports connections up to 28.8 Kbps (only 14.4 Kbps over the packet service). At press time, The Pipeline was purchased by Performance Systems International Inc., which plans to take the service national.

Pipeline Internaut improves on a good thing, and now more people can take advantage of it.

▶ **Pipeline Internaut, Version 2.07.** List price: *Free; $20 for 20 hours of Internet access per month; $35 for unlimited use.* Requires: *8MB RAM, 4MB hard disk space, modem, Microsoft Windows 3.1 or later,* The Pipeline, *New York, NY; 212-267-3636; fax, 212-267-4380.*

Circle 432 on reader service card



SURF'S UP: *Pipeline contains all you'll need to get onto and use the Internet.*

FIRST LOOKS PLUS

From March 13 through 17, you can go on-line to download the client software and discuss Internaut 2.07 with Pipeline founder James Gleick and hosts Rick Ayre and Scot Finnie. Type GO EXEC at any CompuServe ! prompt.

Query Tools

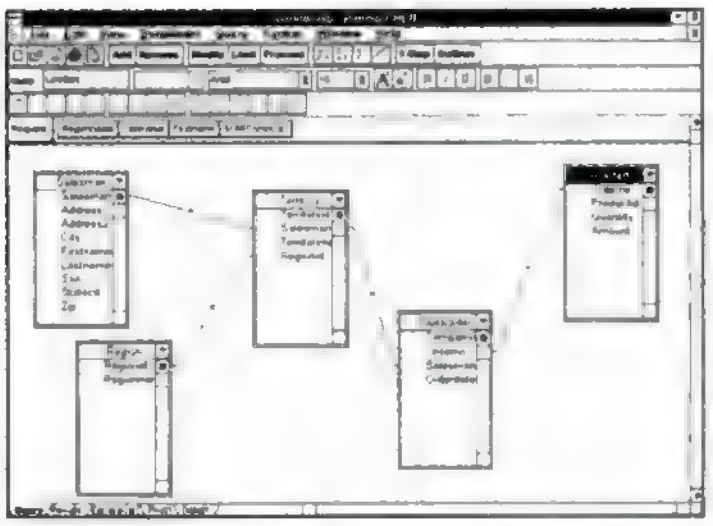
BrioQuery: Tool for Exploring Data

BY BRIAN BUTLER

Brio Technology's BrioQuery Explorer database query and reporting tool has made tremendous inroads in simplifying analysis. Though not as robust as more advanced database tools, Explorer's ease of use is a breath of fresh air.

Explorer is composed of four modules: Detail, Pivot, Query, and Result. The package's greatest strength is its intuitive user interface, which implements drag-and-drop operations and sports tabbed windows. Creating a query in Explorer starts with dragging objects from the program's database catalog to the desktop. Table columns are displayed and are auto-joined with items in other desktop tables that contain columns with the same name, resulting in an entity-relationship (ER) diagram.

We found it easy to alter the ER's structure by clicking on the join line and to filter out rows of data by highlighting the respective column and clicking on the toolbar's limit button. Once the query has been processed, the results are displayed and stored in native format in the Results view. We were able to move columns, delete columns, sort data, and format rows. During our evaluation, the data retrieved from the server proved to be too much, so we added extra constraints and reprocessed the query. The ability to save a query's results is useful if you want to do later analysis.



MAKE THE CONNECTION: *Explorer makes querying as easy as connecting the dots.*

Clicking on the program's Detail report section produced a banded-style report quickly. Though Explorer's reports are adequate for many users, the program falls short of rival products when it comes to producing complex reports, such as composite reports.

The most impressive feature of Explorer is its ability to do crosstab reports quickly and easily. Contained in the Pivot section, Explorer's crosstab abilities are one of the most complete methods we've seen for analyzing multidimensional data. The Pivot section allowed us to summarize data by various attributes, create subtotals and totals, and pivot the report labels on the fly. Once the initial report is complete, you can rearrange the report outline to change your analytical perspective.

At $595, Explorer includes both Windows and Macintosh versions. And its ease of use sets this query tool in a class by itself, though it lacks advanced data reporting capabilities found on products like InfoBuilder or ReportSmith.

▶ **BrioQuery Explorer.** List price: $595. Requires: *4MB RAM, 2MB hard disk space, Microsoft Windows 3.1 or later.* Brio Technology Inc., *Mountain View, CA; 800-486-2746, 415-961-4110; fax, 415-961-4572.*

Circle 433 on reader service card

Application Development

Visual Objects: One-Stop Application Environment

BY SAL RICCIARDI

CA Visual Objects (VO), Computer Associates' client-server programming platform, offers Windows database developers an integrated programming environment and a native code compiler. The $895 product supports object-oriented language and features custom class creation and inheritance, but it can be tough to learn.

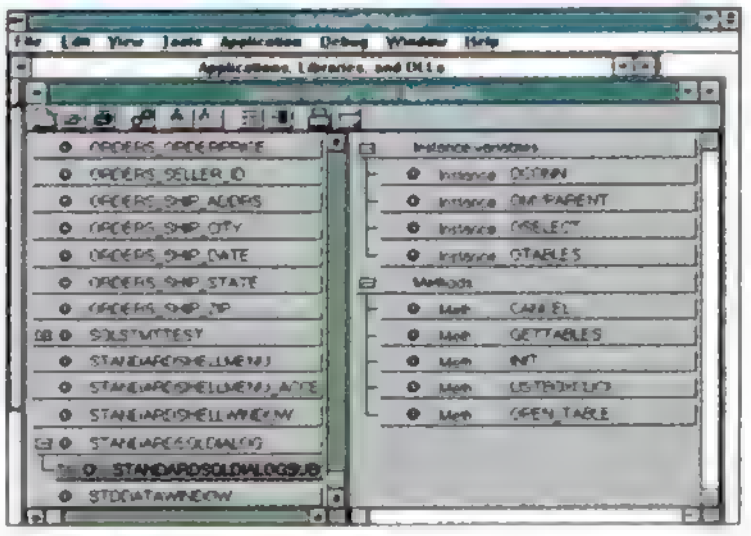
Clipper programmers will appreciate the integrated Xbase development environment. The product is built around an array of browsers and editors that let you create and manage an application as it takes shape.

TOP TO BOTTOM

The first stop is the Application Browser, which gives you access to the highest level in the VO hierarchy—your applications—as well as to system components, classes, libraries, and DLLs. Double click on an application and the Module Browser opens to show all the applications modules. Opening up a module invokes the Entity Browser, which displays all the entities, including functions, procedures, and methods. Double-click on any entity and the appropriate editor opens. At any time, you can choose the Class Browser to browse a list of all the classes and methods used.

The included editors allow the interactive design of menus and windows, the assigning of properties, and the placing of controls such as push buttons and check boxes. The editors then generate code to subclass the built-in classes provided with VO. We used the Menu Editor to interactively design a menu; when we saved it, VO generated the code to implement the menu by subclassing the standard menu class.

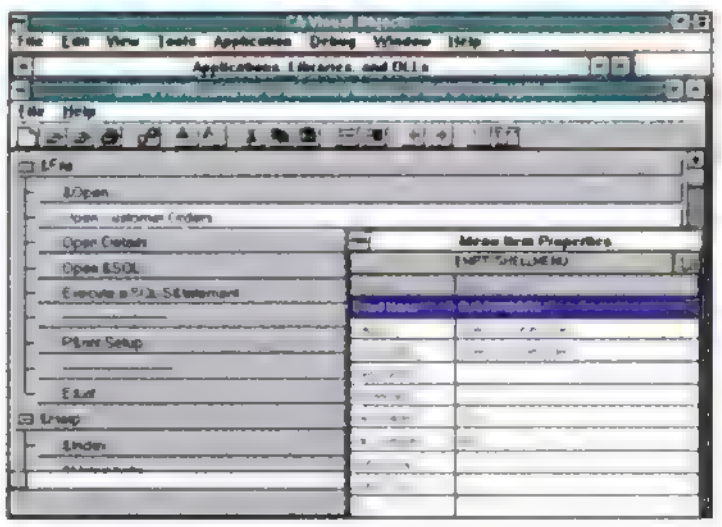
VO also comes with a rich set of supplied classes, including the new Data Server class, a high-level object that provides a common protocol for accessing data from a variety of sources, such as .DBF file format or SQL databases. Once a Data Server is defined, it can be used as the source for a Data Window—a window that automatically accesses and updates a database and manages record movement and concurrency control. Data Windows and Data Servers also provide the foundation for creating one-to-many master-detail forms without having to manually write code.



CLASS ACT: *VO's Class Browser features an expandable list of all the classes and methods used by an application.*

The product can connect to a variety of data sources. VO comes with the Watcom 32-bit local SQL database for testing SQL access code, as well as a number of ODBC (Open Database Connectivity) drivers for various databases including DB2/2, Informix Ingres, Oracle 7, Oracle, and SQL Server.

VO's programming language includes support for class creation, inheritance, encapsulation, and polymorphism. In addition, VO adds a welcome suite of new data types—such as Shortint, Longint, Byte, Word, Dword, Real—and support for Structures, none of which are included in competing products like Borland's dBASE or Microsoft's FoxPro. As a result, you can interface to any Windows API or DLL directly. VO's native code compiler supports strong typing, letting you opt for speed and strict compile time checking. The effect of strong typing on computation-intensive tasks can be dramatic. For example, a loop surrounding an assignment that took 58 seconds to run in FoxPro took only 2 seconds in VO using strong typing; neither FoxPro nor dBASE support strongly typed variables.



MENU MINDER: *The Menu Editor can build an application's menu on the fly so you can see what it looks like as you build it.*

ENTITY BASED UPDATING

VO's code and resource repository manages all of the application components and stores information on relationships, automatically compiling changes as needed. The repository is unique because it works at the entity level instead of at the module level, as do traditional project-manager/MAKE systems. This means VO doesn't have to rebuild entire modules; it can just update a single entity such as a changed procedure or function, making incremental changes less time consuming and prototyping more practical.

Unfortunately, VO has shortcomings: The product's tools are not two-way, so you can not change the generated code without throwing things out of sync. The system lacks engine-based data integrity support for standalone or file-server based applications, such as referential integrity. Robust applications require a client-server platform or a third-party add-on.

VO could also use an interactive query-builder/prototyper. For instance, there's no query editor that can generate SQL code by drawing graphical joins or filling in QBE-style dialogs. While this first version has no class level support for OLE, VO's ability to interface to Windows APIs and DLLs means you can wrestle with OLE directly. Lastly, in this era of cooperative group programming, VO is an island. To manage source code in a workgroup, you have to export programs from the repository to PRG files for use with a source code control system.

Getting the most from VO requires a big investment in learning the class libraries and event-handling system. The reward, though, is an integrated application workspace.

► **CA Visual Objects, Version 1.0.** List price: *$895.* Requires: *8MB RAM (16MB recommended), 50MB hard disk space, Microsoft Windows 3.1 or later.* Computer Associates International Inc., *Islandia, NY; 800-225-5224, 516-342-5224; fax, 516-342-5734.*

Circle 403 on reader service card

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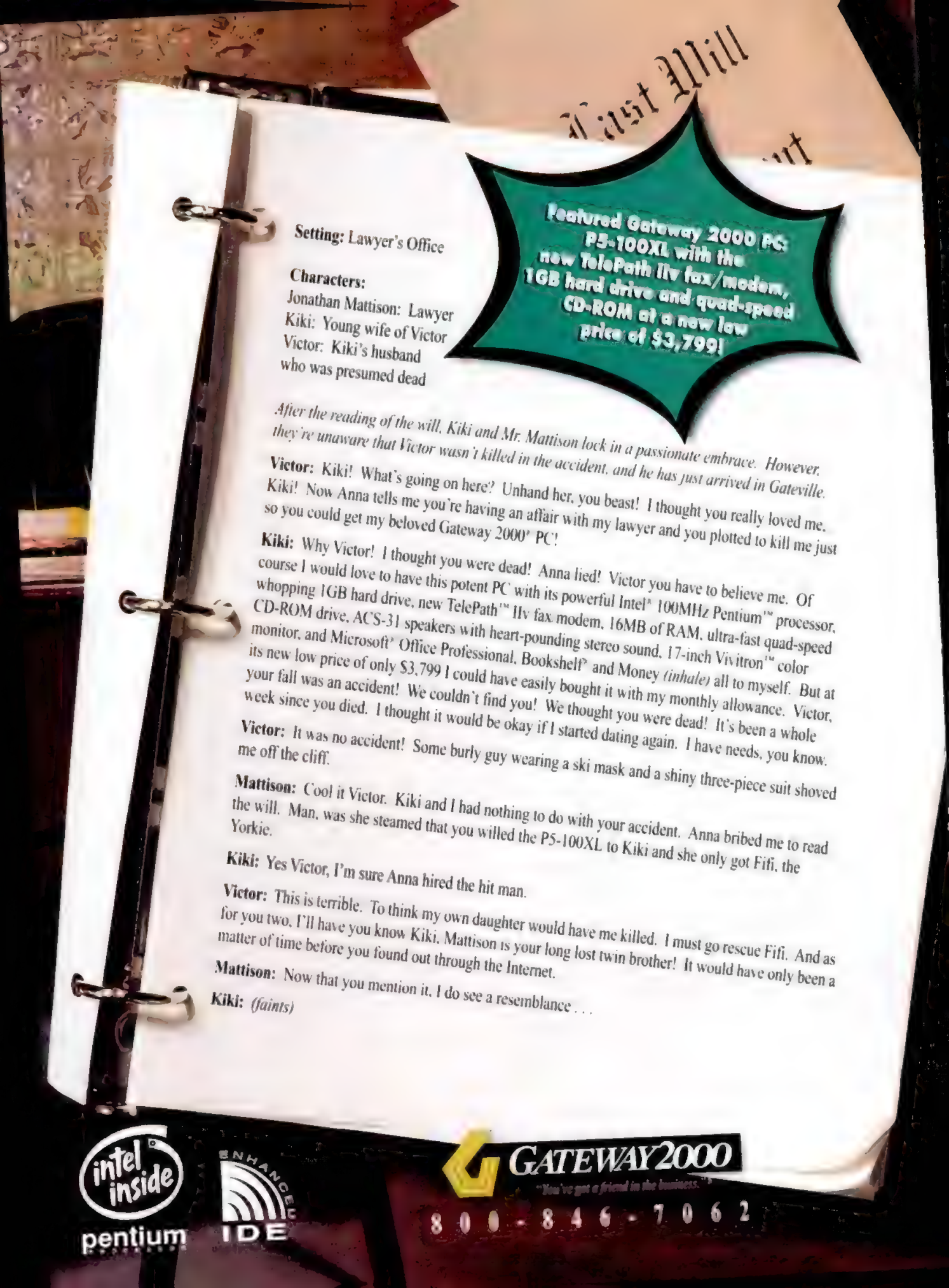
Will the 4DX2-66 Family PC testify against Sheryl?

*Furs pictured are made from artificial materials.


Last Will
Featured Gateway 2000 PC: P5-100XL with the new TelePath IIv fax/modem, 1GB hard drive and quad-speed CD-ROM at a new low price of $3,799!
Setting: Lawyer's Office
Characters:
Jonathan Mattison: Lawyer
Kiki: Young wife of Victor
Victor: Kiki's husband who was presumed dead
After the reading of the will, Kiki and Mr. Mattison lock in a passionate embrace. However, they're unaware that Victor wasn't killed in the accident, and he has just arrived in Gateville.
Victor: Kiki! What's going on here? Unhand her, you beast! I thought you really loved me, Kiki! Now Anna tells me you're having an affair with my lawyer and you plotted to kill me just so you could get my beloved Gateway 2000® PC!
Kiki: Why Victor! I thought you were dead! Anna lied! Victor you have to believe me. Of course I would love to have this potent PC with its powerful Intel® 100MHz Pentium™ processor, whopping 1GB hard drive, new TelePath™ IIv fax modem, 16MB of RAM, ultra-fast quad-speed CD-ROM drive, ACS-31 speakers with heart-pounding stereo sound, 17-inch Vivitron™ color monitor, and Microsoft® Office Professional, Bookshelf® and Money (inhale) all to myself. But at its new low price of only $3,799 I could have easily bought it with my monthly allowance. Victor, your fall was an accident! We couldn't find you! We thought you were dead! It's been a whole week since you died. I thought it would be okay if I started dating again. I have needs, you know.
Victor: It was no accident! Some burly guy wearing a ski mask and a shiny three-piece suit shoved me off the cliff.
Mattison: Cool it Victor. Kiki and I had nothing to do with your accident. Anna bribed me to read the will. Man, was she steamed that you willed the P5-100XL to Kiki and she only got Fifi, the Yorkie.
Kiki: Yes Victor, I'm sure Anna hired the hit man.
Victor: This is terrible. To think my own daughter would have me killed. I must go rescue Fifi. And as for you two, I'll have you know Kiki, Mattison is your long lost twin brother! It would have only been a matter of time before you found out through the Internet.
Mattison: Now that you mention it, I do see a resemblance . . .
Kiki: (faints)
intel inside
pentium
ENHANCED IDE
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Featured Gateway 2000 PC:
The P5-75 Family PC with the new TelePath IIv fax/modem, 2MB of video memory and quad-speed CD-ROM for only $2,299!

Setting: Collapsed Office Building

Characters:
Julia: Successful Realtor
Trevor: Sexy Construction Worker

Julia and Trevor are lovers trapped in a collapsed office building. They could easily call for help with the PC's TelePath™ IIv fax modem, but at the moment neither are in a hurry to be rescued. Julia is frisky, but Trevor's obsessed with her Gateway 2000® PC.

Julia: Trevor! How could you do this to me! You haven't paid any attention to me ever since we discovered my Gateway 2000 P5-75 Family PC™ multimedia system. Are you forgetting about our love child? Come on! Love in the rubble awaits us!

Trevor: Not now Julia! I've just discovered even more bodacious features on this PC! She has a hot new TelePath IIv fax modem with a Messaging Center. We could really use her out at the construction site. She receives, plays and saves voice messages and even lets you access your computer remotely and check for new voice messages. The Messaging Center can send faxes from any Windows™ application that uses a print command and faxes can also be displayed, manipulated and edited, plus a ton of other really cool stuff!

Julia: Trevor, I never knew you were such a geek! Here we are, totally cut off from the rest of the world — it's the perfect time for love. Come to me you stud muffin!

Trevor: Hot damn! This PC is a beaut! She's been souped up with an ultra-fast quad-speed CD-ROM drive and 2MB of video memory — it's faster than grease lightning and a great value at only $2,299!

Julia: Why Trevor, you've made quite a discovery. These new features plus the powerful Pentium™ processor, an immense 730MB hard drive, 15-inch Vivitron™ monitor, 16-bit sound card and Altec speakers are remarkable. But if you don't get those rugged hands off that PC now, you'll regret it!

Trevor: We have to get out of here! I'll use the modem on the TelePath IIv fax/modem to call for help. I have to get to a phone to order an anchovy pizza *and* a PC from Gateway 2000! I need to ask how Bob's doing, too. Gateway is such a great company! I can't wait to get my own PC. I'll get a 30-day money-back guarantee and a three-year warranty on parts for my desktop PC and monitor. Gateway will provide me with technical support for the life of my PC, and on-site service is available during the first year in most U.S. locations. They'll even send me a free written copy of their warranty if I request it.

Julia: That's it! You'll need your own PC because this one is history!

Trevor: Stop! How could you even think of destroying this incredible machine!

Julia: Trevor, my biological clock is ticking. This may be our last chance! We can fax for help afterwards and then you can order your own Gateway PC.

Trevor: Geez. Julia. Okay, but you're kinda a mess.

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GATEWAY 2000 FamilyPC

intel inside
pentium PROCESSOR

Featured Gateway 2000 PC: 4DX2-66 Family PC multimedia system with a double-speed CD-ROM, new TelePath IIv fax/modem and six exciting Microsoft software applications for $1,799!

Setting: A fancy living room in a stately home.

Characters:
Dirk: A debonair businessman
Sheryl: Simone's evil twin sister

Dirk was enjoying a cocktail when he suddenly sensed something was terribly wrong. At the same moment, his wife suddenly whips off a wig revealing that she's Simone's evil twin sister.

Dirk: Sheryl what have you done to me! Where is Simone?

Sheryl: Simone is gone Dirk. Just like you'll be in a few seconds. I poisoned your martini. I want your Gateway 2000® 4DX2-66 Family PC™ multimedia system for myself. Simone always had everything. Flowing auburn hair, a rich husband and a PC that she didn't even appreciate. I desperately need this PC for my eight children. With Microsoft® Encarta™ '95, Penelope will flourish in her studies at the Gateville Junior Academy, and Polly can develop her budding creative talents with MS Fine Artist. Chester can track his stocks with MS Money, and Carlton can use the spreadsheet in MS Works to track his pet iguana's feedings. The rest of the kids can check out movies on MS Cinemania® '95 and sharpen their golf game with MS Golf. The 4DX2-66 will prepare them well for Gateville's competitive job market. If my plan works they'll all support me by the year 2005.

Dirk: You offed Simone?! Why didn't you tell me? I've always loved you. Simone was a raging hypochondriac. She drove me nuts! Quick, get me an antidote. We'll live happily ever after together!

Sheryl: You love *me*? Maybe Simone sensed it and that was why she always said she was me.

Dirk: Sheryl, the antidote, please! I'll give you anything you want. I'll come live with you in Canada!

Sheryl: Oh how sweet. But would we be able to stay in contact with Gateway 2000?

Dirk: Of course! Gateway customers in Canada and Puerto Rico get toll-free telephone service along with technical support. Plus, Gateway has a non-resident importer plan with Canada for easy delivery, and on-site service is available in some Canadian and Puerto Rican locations.

Sheryl: That's nice Dirk, but I'm afraid it's too late. I'm flattered by your offer, but I'd rather have this 4DX2-66 all to myself. Plus, I'll have this house and everything you own since I'm a dead ringer for Simone with this wig. In fact, my eight kids are on a flight to Gateville as we speak.

Dirk: You forgot *(gasp)* one *(choke)* thing. I'm *(cough)* taking *(wheeze)* my Gateway *(choke)* customer *(cough)* I.D. *(gasp)* to my grave! *(THUMP)*

Sheryl: AUUGH!

intel inside

GATEWAY 2000 FamilyPC

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- 15" Vivitron Color Monitor
- Tower Case
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- MS-DOS 6.22 & WFW 3.11
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- Intel 60MHz Pentium Processor*
- 8MB RAM, 256KB Cache
- 730MB 10ms IDE Hard Drive
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- PCI Local Bus Graphics with 1MB
- Quad-Speed CD-ROM Drive
- 3.5" Diskette Drive
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- 3-Year Limited Parts Warranty

P5-60 $1999
P4D-66 $1799

(66MHz 486DX2 CPU w/ double-speed CD-ROM drive & 128KB cache)

P5-75

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- PCI Local Bus Graphics with 1MB
- Quad-Speed CD-ROM Drive
- 3.5" Diskette Drive
- 15" Vivitron Color Monitor
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- 1GB 10ms IDE Hard Drive
- PCI Enhanced IDE Interface
- ATI Mach 64 with 2MB VRAM
- Quad-Speed CD-ROM Drive
- 16-Bit Wavetable Sound Card & Altec ACS-31 Speakers w/subwoofer
- TelePath IIv 14.4K Fax/Modem
- 3.5" Diskette Drive
- 17" Vivitron Color Monitor
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Laser Printers

SuperScript 660: NEC's Dumb Printer Is a Smart Buy

BY DANIEL GROTTA & SALLY WIENER GROTTA

With a street price of about $600, NEC's 6-page-per-minute Silentwriter SuperScript 660 is presently the least expensive 600-dot-per-inch laser printer around. It should appeal to the growing small office/home office (SOHO) market, which demands high-quality products at less-than-corporate prices.

SOHO PRICE TAG: *NEC's Silentwriter 660 is currently the least expensive 600-dpi laser printer.*

To keep the price down, NEC designed the Silentwriter 660 to be a dumb (host-based) printer that has neither its own memory nor a processor. This means that the Silentwriter 660 relies on your computer's CPU to rasterize output.

Although the Silentwriter 660 is a dumb printer, it does have a memory slot for installing an optional 4MB DRAM module. But since this improves speed only marginally, owners would be smarter to put that extra memory into the PC, where it would be much more useful.

NEC outfitted the Silentwriter 660 with a modest 50-page hopper. A more realistic 200-page hopper is $75 extra. The printer ships without cables, and comes with a starter toner cartridge good for only 2,000 pages. The regular cartridge produces around 4,000 pages.

TRUE VIEW: *The 600-dot-per-inch resolution of NEC's Silentwriter 660 yields sharp edges and smooth gradients.*

Despite being a no-frills, device, the Silentwriter 660 is a well-designed printer throughout. It is capable of producing excellent quality output and comes equipped with some impressive features.

For openers, it's a true 600-dpi printer, not a 300- or 400-dpi device that incorporates software interpolation to boost resolution. What's more, NEC's patented Sharp Edge Technology helps reduce aliasing by automatically adjusting the shapes of adjoining dots.

The Silentwriter 660 can produce prints at 6 ppm, but this is a maximum rating, and actual throughput will depend on the host computer's specific configuration. The more RAM you have and the faster your CPU, the higher the throughput will be. The printer's bidirectional parallel interface speeds up data transfer time significantly.

The Silentwriter 660 ships with 45 TrueType fonts, as well as GDI and PCL 5e emulations built in. Software-based Adobe PostScript Level 2 capability is a $99 option. Another nice touch is the printer's ability to add spot color to output by swapping the black cartridge for an optional blue, red, or yellow toner cartridge. The Silentwriter 660 complies with Energy Star specifications.

What we liked best about the printer was its PC-based on-screen control panel, which installed easily into Windows. Overall, it was simple to configure and operate. The Silentwriter 660 capitalizes on its bidirectional parallel interface to let it graphically display detailed printer status information, so you always know what's happening. You can quickly and easily switch emulations, change printing order and orientation, adjust energy-saving functions, and monitor print jobs.

If value and high resolution are at the top of your laser printer wish list, the Silentwriter 660 delivers.

▶ **Silentwriter SuperScript 660.** Estimated street price: *$599.* Requires: *4MB RAM (6MB recommended), 10MB hard disk space, Microsoft Windows 3.1 or later.* NEC Technologies Inc., *Boxborough, MA; 800-632-4636, 508-264-8000; fax, 508-264-8673.*

Circle 426 on reader service card

Charting

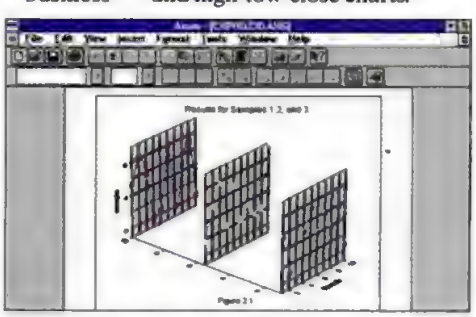
Axum Puts a Spin on Viewing Scientific and Technical Data

BY CRAIG STINSON

When it comes to generating publication-quality graphs of scientific or other technical data, your garden-variety spreadsheet and business-oriented charting programs just won't cut the mustard. One program that will, however, is Axum for Windows 4.0.

This $595 program from Trimetrix provides more than 75 two- and three-dimensional charts that will spruce up any technical paper or presentation. The depth and range of this product is exceptional, given its ability to produce vector, polar, smith, and contour chart types. Axum's user interface is reasonably discoverable, and the program supports OLE 2 as a client only. This lets you drag data from another OLE 2 application, such as Excel 5.0, into Axum.

Unlike Software Publishing Corp.'s Harvard ChartXL (First Looks, November 22, 1994), Axum focuses strictly on technical graphs, omitting business-oriented items such as bubble and high-low-close charts.



COMPUTER SCIENCE: *Axum lets you create complex 3-D charts from technical data.*

In addition to charting, Axum also offers a good variety of data-analysis and manipulation tools for users who have to process and massage large amounts of data. The most important information power tools include automatically calculated error bars, data smoothing (Lowess, weighted-average, Savitsky-Golay, and spline), curve fitting (linear, log, expo-

nential, power, and polynomial), descriptive statistics, ANOVA, goodness-of-fit statistics, and regression analysis.

A number of data transformations can be selected from menu commands, and those users who are proficient in C programming can further massage information via custom scripts and functions written in Axum's programming language.

Axum can handle large data sets. Two-dimensional graphs are limited only by disk space, while three-dimensional types can plot a generous 16,384 data points. Data resides on separately stored data sheets, which may be recalled together with associated graphs via project files. You can enter data directly on the data sheets or import it from a wide variety of sources.

DATA IN, GRAPH OUT

To create a graph, you click on a 2-D or 3-D icon, then select a particular graph type from a palette of buttons. You can populate the chart with data in two ways: either select data before starting, or drag a data block to the newly created blank chart.

To customize a graph, you can either double-click on a display element or work with Axum's unique outline view. In the latter, all the various cus-

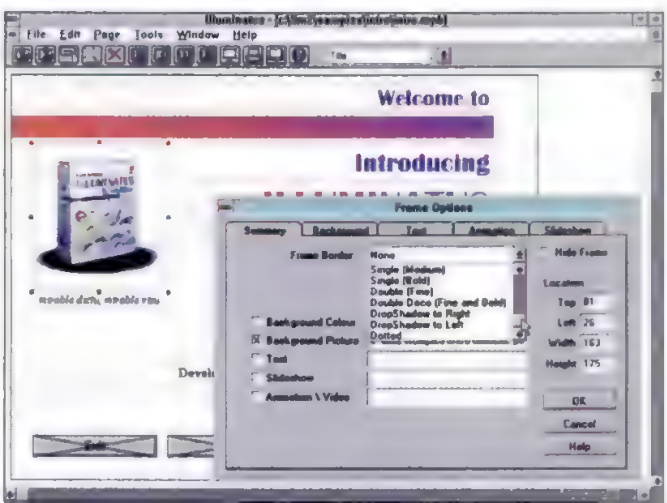
Presentations

Illuminatus Lights the Way to Easy Multimedia Presentations

BY J.W. OLSEN

If your needs don't demand overly complicated and expensive desktop presentation software, JASC's $149 Illuminatus may be just what you've been looking for. This nonprogrammable package lets you prepare reasonably sophisticated multimedia presentations simply by using menus and drag-and-drop capabilities.

Illuminatus presentations—



Once you're on your feet, you can even create your own templates so that all the presentations you produce will have a consistent look and feel. Each presentation template comprises prebuilt page forms that contain editable frames and buttons. Double-clicking on a frame invokes a well-organized, tabbed dialog box from which you edit all of a frame's features. Double-click on a button to connect to

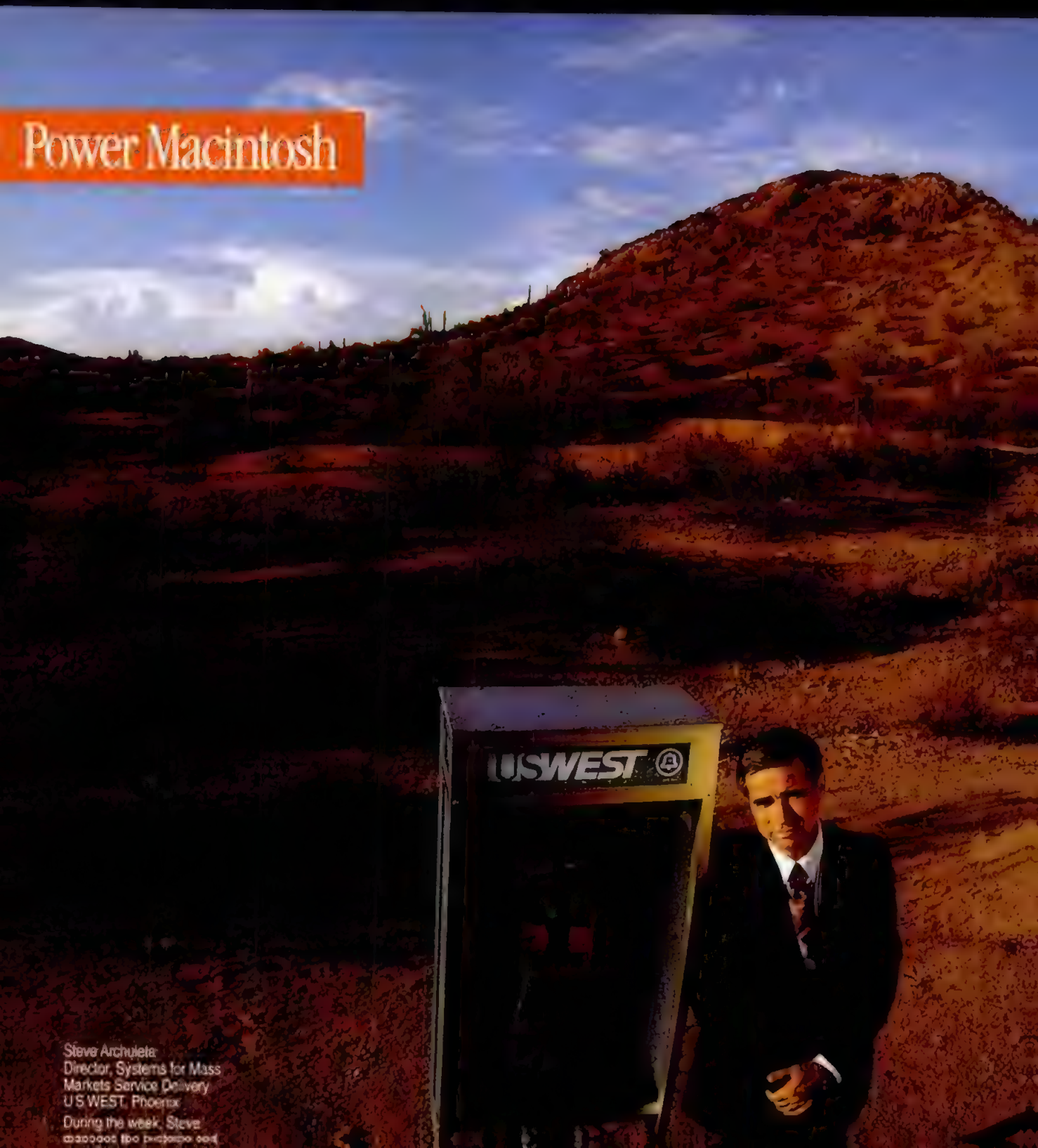
maintenance release that is scheduled to appear sometime in March.

When you are satisfied with your presentation, the program's compile option creates a fully executable, standalone document on your computer. Or, you can choose the publish command to create a distributable version that is compressed and, if necessary, split across several floppy disks. This distribution option comes complete with an installation program—a nice touch.

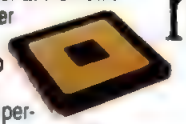
FAMILIAR EDIT TOOLS

Illuminatus' Tools menu options invoke your favorite graphics, text, and sound editor, so when you need to edit, you'll be using the programs with which you're most familiar. Unfortunately, you can't simultaneously load a graphic or other object from your document along with the editor. Illuminatus supports the 10 most popular graphics formats, and audio support is well represented. Also supported are Autodesk Animator and .AVI video files.

By combining these resources with some intrinsic Illuminatus special effects, you can create persuasive multime-


Power Macintosh
USWEST
Steve Archuleta
Director, Systems for Mass
Markets Service Delivery
U S WEST, Phoenix
During the week, Steve

"There's leading edge. And bleeding edge. And you have to walk the line to stay competitive. That's why we use Power Macintosh. It's a RISC PC, so it's leading the way. But it's also a Mac that can run Windows and DOS, so it's compatible with everything we're doing now. That makes Power Macintosh a very safe choice. Which is good for a guy like me. I take my risks on the weekend."



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Apple

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Business CD-ROMs

Information USA: The Ultimate Guide to Free Stuff

BY BARRY BRENESAL

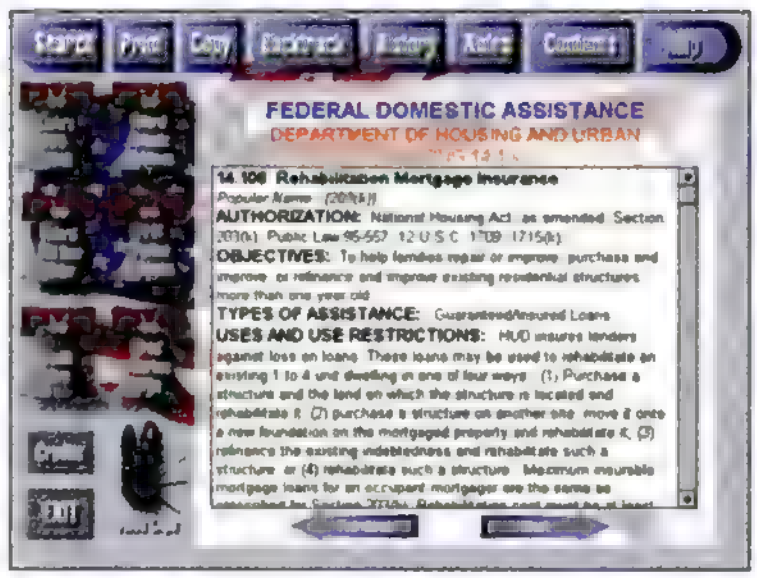
We've all seen the television commercial that offers a gold mine of material about government giveaways and contacts. The $49.95 Information USA 3.0 program is similar, but given a CD-ROM's storage capacity and searching capabilities does much more.

Information USA supplies a generous amount of data in six sections, all with the same slant: harnessing hard-to-access but legally available government information for personal and business gain. Federal Domestic Assistance provides information about all 1,261 federal programs, administered by 51 separate federal agencies. Health Care furnishes data on free or inexpensive treatment and can tell you how to get in touch with health-related clearinghouses and hotlines. The Great American Gripe tells you how and where to complain should you be unfairly treated in any of dozens of ways. 1001 Freebies/Cheapies is self-explanatory.

The Federal Database Finder is probably the most useful part of this CD-ROM, as it includes more than 1,000 addresses and phone numbers of government agencies that lend free advice, right wrongs, and supply important contacts.

Unfortunately, there are a scant few hypertext links throughout the disk, and for the most part, the six sections stand alone. Information USA does offer a superior querying facility that supports whole-word, phrase, wildcard, Boolean, and proximity searches. You can add your own notes to the program's material, print out selections, and copy information to the Windows Clipboard. A History Button lets you quickly backtrack, but once you jump back to a particular section, the program loses track of everything reviewed since that time.

A more serious drawback in a reference guide this large is the general absence of indexing. You can use Information USA's Contents button to check out Department of Energy materials in the Federal Database Finder, for instance, but you have to click forward one screen at a time through hundreds of alphabetical listings. This can be agonizing if you're looking for information that's at the end of the alphabet.



GOLDMINE OF GIVEAWAYS: *Information USA is a treasure trove of government freebies.*

Despite these shortcomings, Information USA's database has something for just about everyone—whether it's freely available data on market studies, resources for investors, or educational grants. If you've ever wondered what sort of useful information was quietly lurking within the walls of the Government, Information USA is a good start.

▶ **Information USA, Version 3.0.** List price: *$49.95.* Requires: *4MB RAM, 1.5MB hard disk space, CD-ROM drive, soundboard, Microsoft Windows 3.1 or later.* InfoBusiness Inc., *Orem, UT; 800-657-5300, 801-221-1100; fax, 801-221-1194.*

Circle 401 on reader service card

Windows Utilities

Versions Keeps Your Revisions Straight

BY DAVID HASKIN

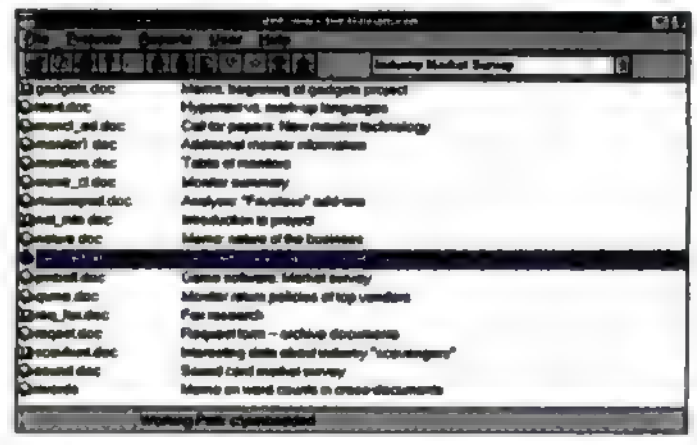
When working in a group, tracking multiple revisions of documents can be more difficult than creating the documents in the first place. Versions for Documents 1.1 ($279) acts as a repository for users to check files into and out of, and tracks changes made.

The focus of Versions is the project. The first step is to create a project-specific directory and fill it with the relevant files. You can then check the files into the Versions tracking system, optionally adding file descriptions. StarBase outfits Versions with a Wizard, which was a huge help in walking us through the sometimes awkward project-creation process.

Project filenames and descriptions appear on-screen with an icon that indicates a file's current status; double-clicking on it opens the file and automatically checks it out. You can also use a dialog box to check out multiple files or older versions. After making revisions, you check documents back in, adding comments if you wish. Network users lock the document during revisions to prevent simultaneous access.

You can designate a maximum number of revisions for each document to keep from cluttering up your hard disk. After the threshold is reached, the oldest revisions are automatically deleted.

Versions can also compare documents in side-by-side windows, with the differences highlighted—but it can't merge the differences into a single file.



REMEMBER WHAT YOU DID: *Versions for Documents helps track revisions.*

A nice touch is the ability to drag files from File Manager to the Versions work area to check them into the currently displayed project. The program can send comments or revised files via MAPI-compliant (but not VIM-based) e-mail systems.

StarBase ignores some document-management basics. For example, you can't create new documents from within Versions. Also, there is no built-in security beyond locking files during network use. Nor does Versions track how long a user has had a document checked out.

If you are a busy author or part of a collaborative workgroup, Versions for Documents will help you keep your revisions straight.

▶ **Versions for Documents, Version 1.1.** List price: *$279.* Requires: *4MB RAM, 4MB hard disk space, Microsoft Windows 3.1 or later.* StarBase Corp., *Irvine, CA; 800-997-8272, 714-442-4400; fax, 714-253-6712.*

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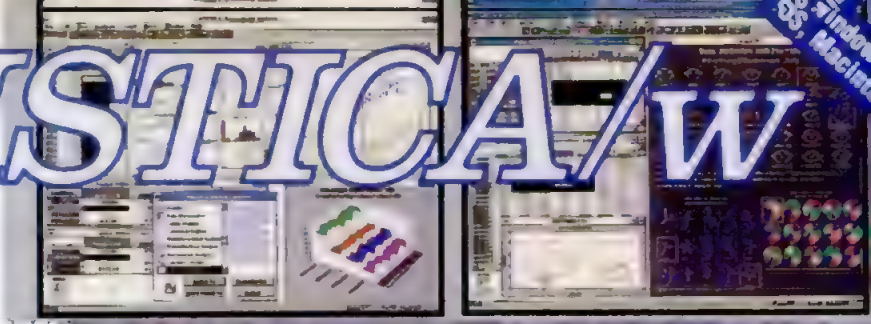
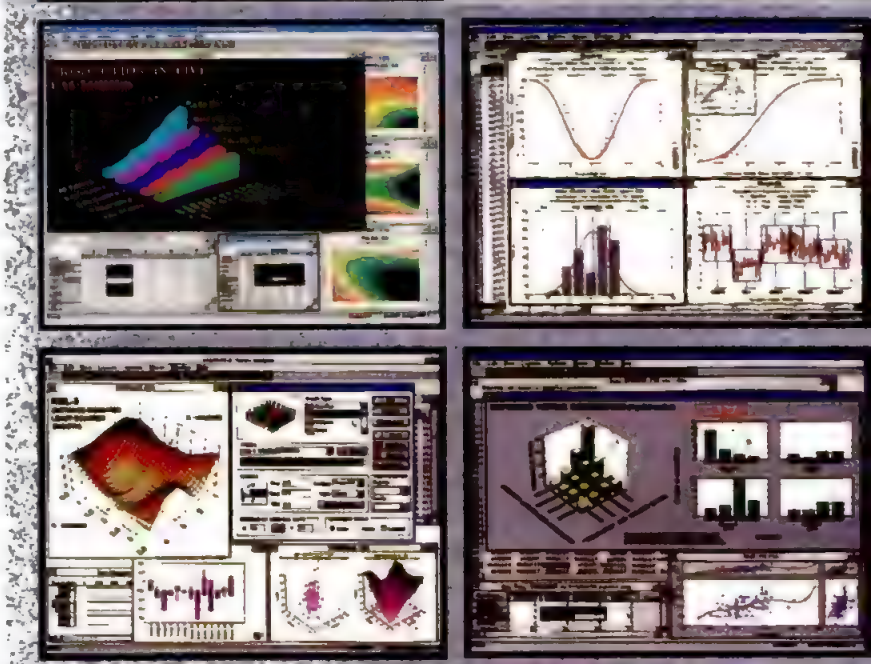
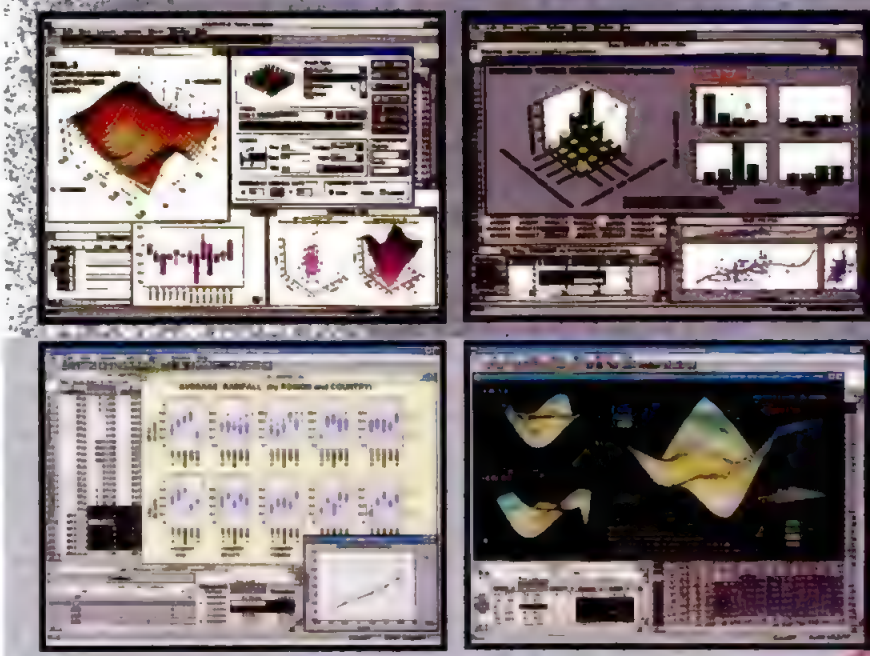
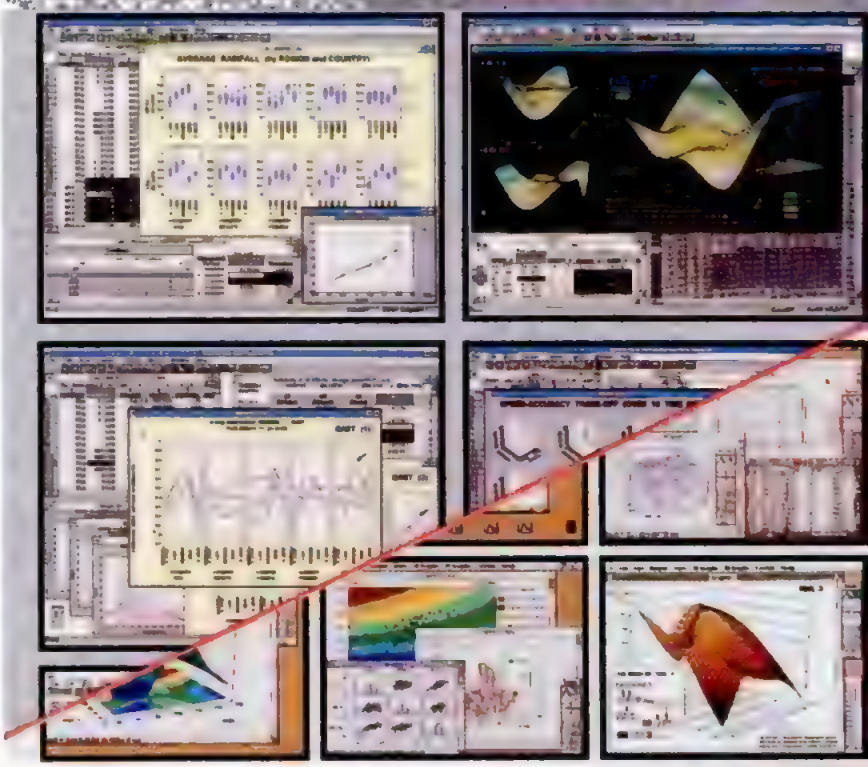
STATISTICA/W









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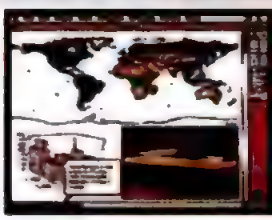

Windows Utilities

OnFile Organizes by Chapter and Verse

BY J.W. OLSEN

Using the familiar—if well-worn—bookshelf metaphor, Software Publishing Corp.'s $49.95 OnFile 1.0 makes it easier to find and view files that are hidden on your hard disk.

You fill OnFile's unlimited bookshelf by first naming a book for a project category (for example, Annual Reports); you then assign specific chapters (such as Annual Report 1995). Finally, you fill the chapter's pages with topics (such as the word processor documents, spreadsheets, and images that comprise the project). Each topic has a filename (for which you can substitute a 255-character alias), up to 1,024 characters of descriptive text, and a thumbnail to serve as a visual reminder.

The OnFile library has both a table of contents and an index, and the program includes a proprietary version of Systems Compatibility's Outside In for Windows, which displays 50 common file formats. Just click on the View icon to display the file or double-click on a topic whose application is an OLE 2–compliant server to bring up the document. You can also add electronic notes, send chapters or entire books over a VIM or MAPI e-mail network, or synchronize books on different PCs through floppy disks.

OnFile is easier to use than either the Windows File Manager or XSoft's TabWorks, and presents more options. If finding files is a perpetual challenge, there is no need to wait for Windows 95's document-oriented approach. OnFile 1.0 is ready today.

▶ **OnFile, Version 1.0.** Estimated street price: *$49.95.* Requires: *4MB RAM, 5MB hard disk space, Microsoft Windows 3.1 or later.* Software Publishing Corp., *Santa Clara, CA; 800-234-2500, 408-986-8000; fax, 408-980-0729.*

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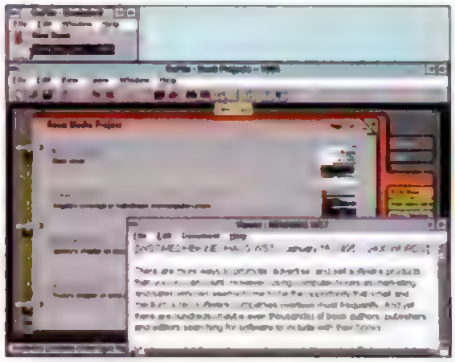

BOOK IT: *OnFile's book metaphor helps you to organize all the files associated with a project.*

Portable Printers

Is That a Printer in Your Pocket? Pentax Redefines Portability

BY ASA SOMERS

Printer miniaturization achieves new heights with the $499 Pentax PocketJet, a sleek 1.1-pound unit that measures just 1.2 by 10 by 2.2 inches (HWD). By using direct thermal technology, the PocketJet produces 300-dot-per-inch resolution on special paper at a cost of 8 cents per sheet.

Nearly one-quarter the size of its closest rival, the Citizen Portable II, the PocketJet is capable of printing up to 3 pages per minute. In text printing, the PocketJet's output was comparable to a desktop laser printer, while basic graphics pages showed some banding. Complex graphics overwhelmed the PocketJet, yielding garbled or half-completed documents.

The use of thermal paper is the PocketJet's Achilles' heel. The paper is not as shiny or flimsy as thermal fax paper and will suffice in emergencies, but it's probably not appropriate for distribution at a board of directors' meeting. The PocketJet features HP LaserJet IIP emulation and comes with 100 sheets of thermal paper. Additional paper costs $7.99 per 100-sheet box. The nickel cadmium battery produced 13 text pages and 8 graphics-heavy pages on a single charge; a complete recharge takes about 70 minutes.

The PocketJet is the most portable printer we've seen. It's so small, in fact, that you might lose it among the papers you print out.

▶ **Pentax PocketJet.** List price: *$499.* Requires: *PC with parallel port.* Pentax Technologies Corp., *Broomfield, CO; 800-543-6144, 303-460-1600; fax, 303-460-1628.*

Circle 428 on reader service card

LEAN AND MEAN: *The PocketJet produces laser-quality output at three pages per minute on thermal paper.*

Wireless

Walkie-Talkie for Your Printer

BY BRAD STILWELL

No time to hook up your notebook to the office printer? Merritt Computer Products' Cordless Printer Sharing Kit ($239.95) will make the connection for you and minimize the hassle.

This lightweight wireless system is targeted at small offices and workgroups; it consists of a 900-MHz transmitter and a receiver that are each 5.75 by 3.75 by 2.2 inches (HWD) and a parallel connector cable. Just plug the transmitter into your PC's parallel port and the receiver into your printer, and you're ready to print. Each receiver will serve up to 16 users (additional receivers are $119.95), and each user can send jobs to four different printers by changing the transmitter's frequency.

While Merritt claims that the system can print jobs at a distance of up to 100 feet, we found that with a Hewlett-Packard LaserJet IIIp Plus printer the signal could not reach beyond 35 feet in a typical office. The Merritt system is also slow, taking 2 minutes 7 seconds to print a one-page Microsoft Word 6.0 for Windows document, compared with 39 seconds via a parallel cable.

Still, if you're looking to save time and cable when connecting printers, the Cordless Printer Sharing Kit is a reasonably priced and easily installable solution for a small office.

▶ **Cordless Printer Sharing Kit.** List price: *$239.95.* Requires: *PC with parallel port.* Merritt Computer Products Inc., *Dallas, TX; 800-627-7752, 214-339-0753; fax, 214-339-1313.*

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REACH OUT AND PRINT: *Merritt's cordless print system connects your PC to a printer without cables.*

Powerhouse performance with exceptional portability.

The HP OmniBook 600

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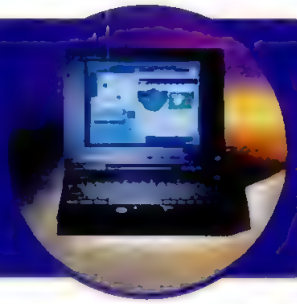
The HP OmniBook 4000



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- *Up to 520-MB hard disk drive*
- *Type III PCMCIA card slot (or use as two Type II)*
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PC MAGAZINE EDITORS' CHOICE™ January 24, 1995 HP OmniBook 600

When it's time to get your show on the road, take along a great performer that carries its own weight. Like an HP OmniBook notebook PC.

For rich, vibrant color plus full stereo sound in an easily portable package, there's nothing like the HP OmniBook 4000 for impactful presentations. Then there's the winner of this year's *PC Magazine* Editor's Choice Award, the HP OmniBook 600. At just 3.8 pounds, it packs all the performance you need into a slim package.

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- *Chip upgrades to higher performance*
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- *210-MB hard drive[1]*
- *4-MB RAM, expandable to 64-MB*
- *512 KB or 1 MB of Video RAM standard*
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- *Local bus Fast-IDE hard disk interface***
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High-performance network-ready PCs in a slimline package.

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- *270-MB, 14-ms Fast-IDE hard drive[1]*
- *32-bit Fast-IDE local-bus hard disk interface*
- *8-MB RAM, expandable to 96-MB*
- *Ultra VGA2 local-bus accelerated video supporting up to 1280 x 1024 resolution*
- *Optional integrated 10Base-T networking*
- *Systems Diagnostics Utility*
- *EPA Energy Star certified*
- *ISA Autoconfiguration utility (Plug-n-Play)*
- *Integrated Desktop Management Interface (DMI)[3]*
- *Free three-year limited warranty for parts and labor[2]*

Exceptional 486 performance for advanced business use.

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from
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- *PCI architecture*
- *Standard 256-KB second level write-back cache*
- *Four mass storage shelves; four expansion slots*
- *Two available 32-bit PCI expansion slots*
- *210-MB, 14-ms Fast-IDE hard drive[1]*
- *32-bit PCI IDE hard disk interface*
- *8-MB RAM, expandable to 96-MB*
- *PCI Integrated 64-bit S3 Vision-864 graphics accelerator supporting up to 1280 x 1024 resolution*
- *Optional PCI Integrated 32-bit 10Base-T networking*
- *Integrated Desktop Management Interface (DMI)[3]*
- *EPA Energy Star certified*
- *Free three-year limited warranty for parts and labor[2]*

intel inside

*Source: 1994 J.D. Power and Associates Desktop PC Customer Satisfaction Study.℠ Study conducted among business users and based on 1,528 user respondents.
**Feature included with some models. All HP Vectra PCs come with MS-DOS® 6.2 and MS Windows for Workgroups 3.11 pre-installed; HP mouse and keyboard included.
[1]U.S. list price, dealer prices may vary. Monitor not included. [2]Other capacities available. [3]First year on-site, 24-hour service. Second and third year return to dealer.
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- *270-MB, 12-ms Fast SCSI-2 hard drive[1]*
- *Integrated 32-bit PCI SCSI-2 interface*
- *PCI integrated 64-bit S3 Vision-864 graphics with 1280 x 1024 resolution or PCI MGA Ultima Plus graphics with up to 1600 x 1200 resolution*
- *32-bit PCI IDE hard disk interface*
- *8 or 16 MB of RAM, expandable to 256 MB*
- *PCI Integrated 32-bit 10Base-T networking*
- *Integrated Desktop Management Interface (DMI)[3]*
- *Free three-year limited warranty for parts and labor[2]*

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J.D. POWER AND ASSOCIATES
PC USERS • 1994

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DESKTOP PC CUSTOMER SATISFACTION STUDY*
OCTOBER, 1994

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March 16, 1993
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CIRCLE 226 ON READER SERVICE CARD

New & Improved

NEWS OF ANNOUNCED PRODUCTS AND UPGRADES

By Asa Somers

NEW

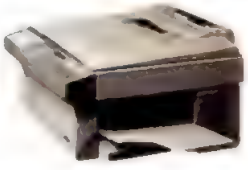
Two Multifunction Devices Deliver The Goods to SOHO Users

Canon U.S.A. and **Lanier Worldwide** have recently introduced all-in-one document-processing devices that combine faxing, printing, and copying capabilities. Both the Canon MultiPASS 1000 and the Lanier 5010 MFD are targeted at small-business and SOHO markets, but each has its own emphasis.

The Canon MultiPASS 1000.

The MultiPASS 1000 connects to your PC through a bidirectional parallel interface and prints directly from or scans directly to many leading software applications; its scanner is Twain-compliant. The $1,600 model uses Canon's Bubble Jet printing technology to produce 360-dot-per-inch resolution and 64 gray-scale levels at a speed of 2 pages per minute (ppm). The MultiPASS 1000 comes with a 30-sheet automatic feeder, a telephone handset, and a 200-sheet cassette for either letter- or legal-size paper. Its memory can store up to 70 pages of incoming faxes while the machine is printing from a PC.

The Lanier 5010 MFD.



The Lanier 5010 MFD is a more heavy-duty offering, which explains its list price of just under $4,000. The unit uses laser printing technology to produce up to 10 ppm at 300 dpi. It includes a 250-sheet cassette and 1MB of printer memory (upgradable to 5MB). The 5010 MFD has 265K of separate fax memory that holds up to 15 pages and lets you simultaneously fax and print without slowing print speeds. It maintains up to five password-protected fax mailboxes and connects to your PC to allow for faxing directly from the desktop.

▶ **Canon MultiPASS 1000.** List price: *$1,600.* Canon U.S.A. Inc., *Lake Success, NY; 800-828-4040; fax, 800-231-9243.*

Circle 405 on reader service card

▶ **Lanier 5010 MFD.** List price: *$3,895.* Lanier Worldwide, *Atlanta, GA; 800-708-7088, 513-252-9541.*

Circle 406 on reader service card

HOT PROSPECT

Latest Deskpro Adds 90-MHz Power and Virus Protection

Along with a new PCI bus architecture designed to maximize Pentium processing power, the Compaq Deskpro XL 590, from **Compaq Computer Corp.**, features a 90-MHz CPU. While the XL 590 hits the market well after other 90-MHz systems, it comes standard with Compaq's SafeStart Virus Detection system, a hardware-based scanner that checks the PC every time it's turned on and identifies when an unauthorized change has occurred.

All XL 590 models are equipped with 16MB of RAM and 2MB of VRAM; integrated business audio, which allows for voice annotation and voice recognition; and a total of five internal expansion slots. In addition, the XL 590's Vocalyst keyboard has an integrated speaker and microphone, volume control, external microphone and headphone jacks, and a mouse port.

Compaq has included 256K of write-back cache in each XL 590 and has developed the new TriFlex/PCI bus architecture to optimize Pentium-based graphics performance. In testing, the XL 590 received a score of 128 on our Winstone 95 benchmark test, placing it well above the average for Pentium/90 systems.

▶ **Compaq Deskpro XL 590.** List price: *With 16MB RAM and a 535MB hard disk (monitor not included), $3,999.* Compaq Computer Corp., *Houston, TX; 800-888-5858.*

Circle 404 on reader service card

IMPROVED

GoldMine 2.5A Automates, Updates, and Integrates

ELAN Software Corp. has recently announced an upgrade to GoldMine for Windows, its Editors' Choice–winning contact-management software. Version 2.5A adds the Automated Processes feature, which lets you automate routine business tasks through a dialog-driven tracking method. Also new to GoldMine 2.5A are DDE links that integrate with applications such as Microsoft Office and Delrina WinFAX Pro. Designed to support network use, the package features network scheduling capabilities and remote data updating; this new version adds modem support for automated remote file transfer. GoldMine 2.5A for Windows also includes its own network-based e-mail system.

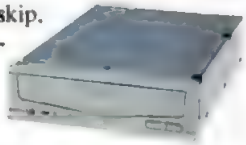
▶ **GoldMine 2.5A for Windows.** List price: *Single-user version, $150; five-user network version, $350.* ELAN Software Corp., *Pacific Palisades, CA; 800-654-3526, 310-454-6800; fax, 310-454-4848.*

Circle 414 on reader service card

NEW

Chinon's Spin: Quad-Speed CD-ROM Drive Under $200

Keep on the lookout for the Chinon CDS-545 quad-speed CD-ROM drive, available from **Chinon America** in the second quarter of this year. The Enhanced IDE CDS-545 will support a maximum transfer rate of 630 KBps, a 230-ms average seek time, and a 128K data buffer. The best news is that Chinon expects the drive to sell on the street for under $200. The CDS-545 also serves as a standalone audio CD player, with front-panel controls that you can operate independently of the computer to open or close the tray; play, skip, or stop a program; random play; and auto-scan.



The CDS-545 CD-ROM drive plugs into an Enhanced IDE port.

▶ **Chinon CDS-545.** Estimated street price: *$199.* Chinon America Inc., *Tor-*

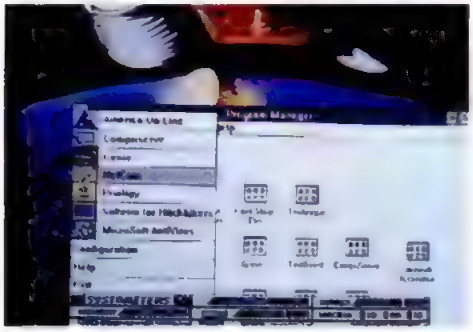
Photography by Thom O'Connor

rance, CA; 800-441-0222, 310-533-0274; fax, 310-533-1727.
Circle 408 on reader service card

IMPROVED

Thumbing a Ride On-Line

Talk about an on-line sampler: **Moon Valley Software**'s Hitchhiking on the Information Highway, Version 2.0, contains trial subscriptions to America Online, CompuServe, GEnie, and Prodigy, and now gives you 400 free hours of Internet access via NetCom's NetCruiser WWW browser. This CD-ROM–based grab bag of Internet communications



INTERNET OR BUST: Hitchhiking 2.0 gives you 400 free hours of Internet connection via NetCom.

apps also includes video simulations, reference guides, and a travel atlas to help you on your journey through cyberspace. Version 2.0 also includes WinRamp Lite, a communications package from Vironix.

▶ **Hitchhiking on the Information Highway, Version 2.0.** List price: *$69.99.* Moon Valley Software, *San Luis Obispo, CA; 800-473-5509, 805-781-3890; fax, 805-781-3898.*
Circle 409 on reader service card

IMPROVED

Point-and-Click Applications Development for the Masses

If you're trying to develop applications and you don't have much programming experience, a graphical environment with some handy push-button tools would certainly help. **SPI** has introduced Version 2.0 of its WindowBASE Rapid Application Development (RAD) tool and relational database to target nonprogrammers. WindowBASE lets you "shuttle" among all design and testing activities by clicking on a button. Meanwhile, the connection to data is managed invisibly by the package's MetaLayer, which resides between your application and the data, providing multiple levels of connectivity. For more involved uses, WindowBASE provides the DASL scripting language, support for OLE, and the Open Access relational database engine. The optional XBase Connectivity Pack ($79) lets WindowBASE use Open Access or XBase data.

▶ **WindowBASE, Version 2.0.** List price: *$495 (competitive upgrade, $149).* SPI Inc., *San Diego, CA; 800-937-4774, 619-450-1526; fax, 619-450-1921.*
Circle 412 on reader service card

BRIEFS

SOFTWARE

Ashlar recently announced Vellum 2.7 for Windows, the latest version of the company's 2-D and 3-D design software. Version 2.7 adds the Dimension Editor, which lets you alter nearly every aspect of a dimension; the Line Pattern Editor, which lets you create custom line patterns; and the Pen Weight Editor, a feature for designing custom pen weights. The 2-D package lists for $2,495 and the 3-D package lists for $2,995; registered owners can upgrade for $395. 800-877-2745; fax, 408-746-0749.

Equilink On-Line, a new on-line service from **Equilink**, provides electronic classified advertisement for listing new and used computer and office equipment for sale, a searchable database of available items, and an e-mail system for communicating with other buyers and sellers. The Equilink service is sold by subscription, with prices ranging from the basic $69 2-hour connection package to the $749 yearly package, which gives you 64 hours of connect time. 800-330-8737.

STS Systems has announced Release 2.3 of SmartLook, a $495 Windows-based tool that lets users view and search mainframe and PC-based reports, as well as selectively print only needed information. Release 2.3 can automatically export data into other formats, such as Lotus 1-2-3 or Microsoft Excel, and can initiate an unsupervised indexing of a report. 514-426-0822; fax, 514-426-0824.

Jurisoft has introduced two new utilities for legal professionals. Full-Authority locates, alphabetizes, and cross-references citations and assigns them to specific categories. It can separate state and federal cases and statutes and expand abbreviations. CiteRite II checks the form and style of your citations against the rules of the Harvard Bluebook or the California Style Manual, highlights any mistakes you have made, and shows you the correct form. The two utilities list for $189 each when purchased separately or for $340 when bundled together. 800-752-2640

NEW

Your PC Never Sounded So Good

When you can no longer bear to hear your multimedia files played through your PC's tin-can speaker, consider the HTP MM line of multimedia speakers from **HTP International.** The series comprises four models, beginning with the $149.95 pair of MM-1 two-way bookshelf speakers with a frequency response of 100 Hz to 18 kHz. The $199.90 MM-2s have 4.5-inch cone woofers and 0.5-inch tweeters for a frequency response of 85 Hz to 18 kHz, while the $249.95 MM-2.5s have 5.25-inch woofers and include a 30-watt power amplifier, increasing their response to 70 Hz to 18 kHz. The top-of-the-line $399.95 MM-3 system uses a pair of MM-1s as mid- and high-range satellites and adds a 6.5-inch subwoofer containing its own power amplifier; the system's frequency response is 45 Hz to 18 kHz.

SOUND OFF: The MM-3 system has MM-1s with an added subwoofer.

▶ **HTP MM series.** List price: *From $149.95 to $399.95.* HTP International, *Anaheim, CA; 714-937-9300; fax, 714-937-9309.*
Circle 410 on reader service card

NEW

Intergraph's Transcend Loses Nothing in the Translation

Intergraph Corp. has engineered DP/Translator, its robust Unix-based language-translation system, into a similarly full-featured Windows-based program called Transcend. This new 32-bit package translates text to or from common European languages while preserving the format of the original document. It is designed either to work as a standalone translator or to be accessed directly from a pull-down menu in a word processor. Transcend is Microsoft Office–compatible and can integrate

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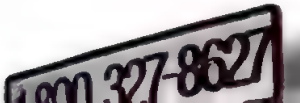

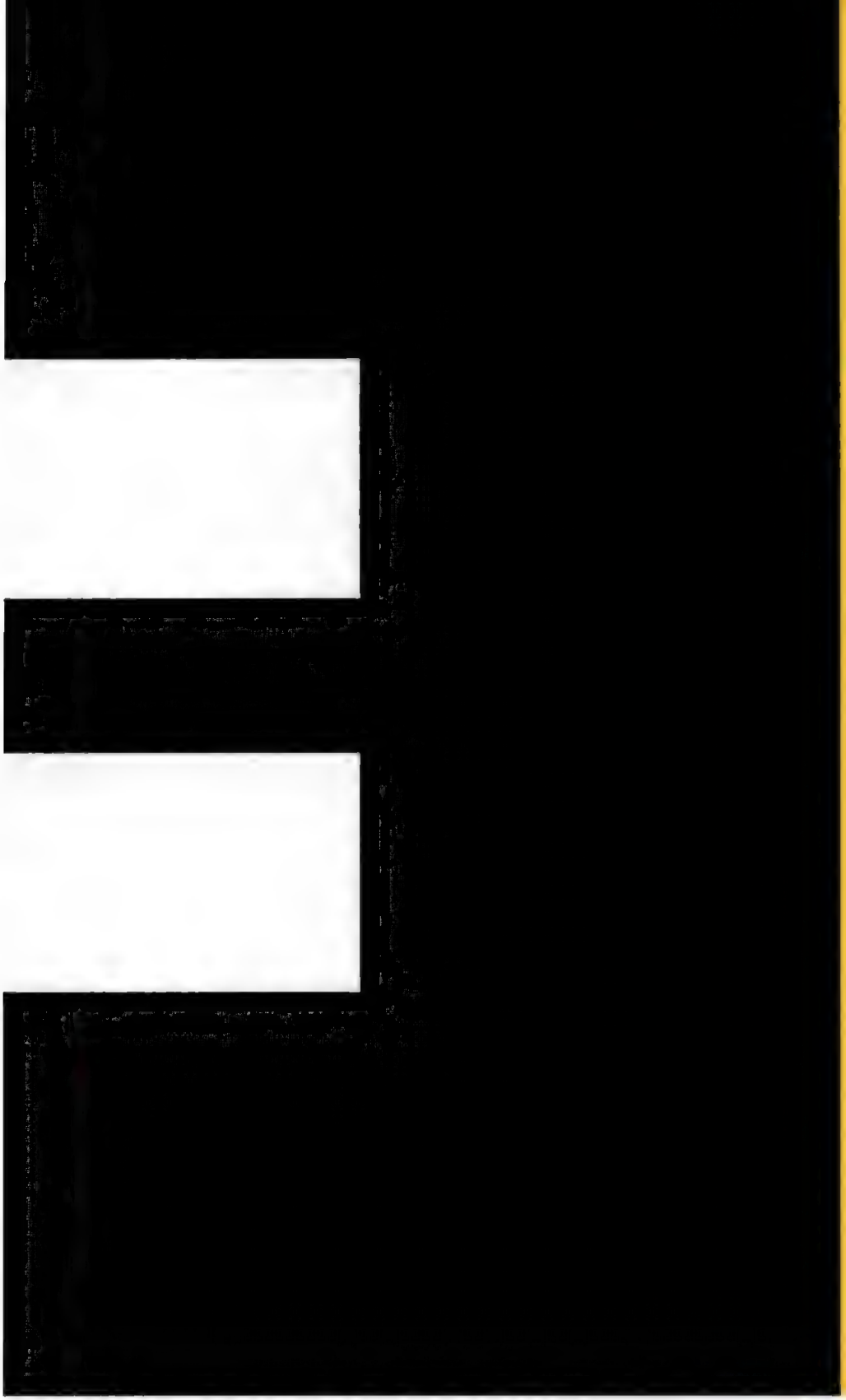

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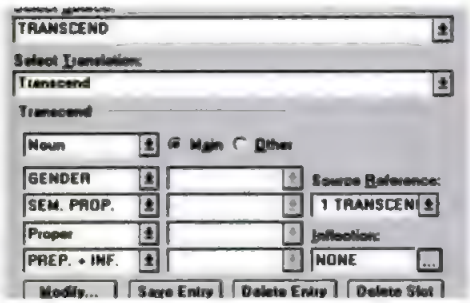


IT'S ALL GREEK TO ME: Transcend helps you choose verb tenses and spellings.

into Wordperfect 6.0. It supports many other applications as well, including QuarkXpress and FrameMaker. Initially, Intergraph will offer translation modules for Spanish and French; German, Portugese, and Italian versions should be available soon. Unfortunately, you must purchase separate packages to translate to and from English into another language.

▶ **Transcend.** List price: *$495 ($295 until April 30, 1995).* Intergraph Corp., *Huntsville, AL; 800-222-9242, 205-730-9832; fax, 205-730-9835.*

Circle 411 on reader service card

NEW

The ColorBook² Squares Off

The ColorBook² comes with 16-bit audio.

Lightweight full-featured notebooks are the objective for portable computer manufacturers, and **Gateway 2000** has weighed in with the latest addition to its ColorBook family, the ColorBook². Available in either DX2/50 or DX4/100 configurations, the unit weighs 5.7 pounds and measures 1.8 by 11.7 by 8.5 inches (HWD). The ColorBook² can accommodate up to a 720MB hard disk and 24MB of RAM. It features a 10.3-inch passive-matrix color screen and supports a maximum resolution of 1,024-by-768 with 16 colors. Gateway has included 1.5MB of VRAM, a 14.4-Kbps modem, an 85-key keyboard with an EZ Point input device, and two Type II PCMCIA slots. The notebook's nickel hydride battery pack provides up to 3 hours of continuous use between charges. The ColorBook² also features integrated 16-bit audio with an internal speaker and microphone and speaker jacks.

▶ **ColorBook².** List price: *From $3,499.* Gateway 2000, *North Sioux City, SD; 800-846-2000, 605-232-2000; fax, 605-232-2023.*

Circle 413 on reader service card

BRIEFS

HARDWARE

Advantage Memory Corp. has released the Advantage SCSI PC Card, which lets you connect up to seven SCSI peripherals to a single Type II PCMCIA slot. The $189 hot-swappable SCSI PC Card achieves a data-transfer rate of 3 MBps and supports the Plug and Play standard. 800-245-5299; fax, 714-453-8158.

For high-end desktop scanning situations, **Mustek** offers the Paragon 1200 Combo, a 24-bit flatbed model that supports an optical resolution of up to 600 by 1,200 dpi. The $999 Paragon comes with a transparency adapter, allowing for scans of positive transparencies of up to 8 by 10 inches, and supports standard reflective scans of up to 8.5 by 14 inches. It comes with iPhoto Plus image-capturing software, the Wordlinx 2.0 OCR package, and a Twain driver. 714-250-8855; fax, 714-250-3372.

ADI Systems has introduced two new monitors, the $329 14-inch Microscan 3V and the $409 15-inch Microscan 4V. The 3V supports a maximum noninterlaced resolution of 1,024-by-768 with a 0.28-mm dot pitch, while the 4V has an Invar mask and supports up to 1,280-by-1,024. Both models are Energy Star– and MPR II–compliant and feature full-screen display, which provides more viewable real estate. 408-944-0100; fax, 408-944-0300.

Logicode Technology is shipping two new additions to its Quicktel line of V.34 modems: the $259.99 2814HV internal model and the $279.99 2814XV external model. Both feature a 28.8-Kbps data-transfer rate and 14.4-Kbps send/receive fax modem capabilities. They come standard with caller ID support and Delrina 4-in-1 fax software. 800-735-6442.

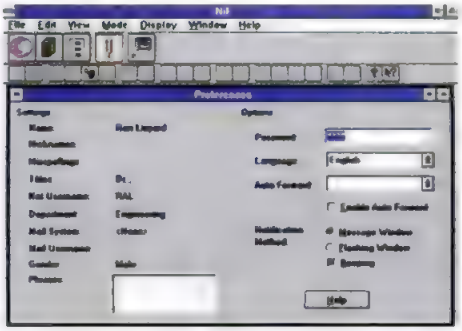
AND FINALLY. . . .

Canon Computer Systems has lowered the list price of its BJC-4000 Bubble Jet color printer to $399. . . . **Seiko Instruments USA** has announced reduced pricing on its single- and dual-technology color printers; some models will be discounted up to $1,000 off the original list prices.

NEW

Fax Marks the Spot

Mitek Systems has introduced a product that will reduce an office's paper flow by routing faxes to individual workstations on a LAN. Network Intelligent Fax-Mail, called NiF, uses intelligent character recognition (ICR) to sort hand-addressed (noncursive) and machine-printed faxes and send them to the proper recipients on a network. The software can discard junk faxes (those without a particular addressee), route faxes to a specific department, or notify a user of an incoming fax via cc:Mail or Lotus Notes e-mail systems.



NiFTY: Let your network sort and deliver incoming fax transmissions.

▶ **Network Intelligent Fax-Mail.** List price: *Five-user license, $249.* Mitek Systems Inc., *San Diego, CA; 619-587-9157; fax, 619-587-0825.*

Circle 407 on reader service card

NEW

Command Center Boards Signal Diamond's Telephony Debut

Diamond Multimedia Systems, maker of the Diamond Stealth line of graphics accelerators, has entered the telephony market with its two Command Center expansion boards for desktop systems, which combine fax and modem capabilities with 16-bit audio. The entry-level Command Center board integrates Sound Blaster Pro–compatible audio with a 14.4-Kbps fax modem, while the high-performance version includes a V.34 modem with speakerphone technology built in. Both models offer upgrades for wavetable synthesis and come with telephone answering machine software, an Internet connection, and digital audio software.

▶ **Command Center series.** List price: *Entry-level product, $199; high-performance product, $299.* Diamond Multimedia Systems Inc., *Sunnyvale, CA; 408-736-2000; fax, 408-730-5750.*

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Photograph by Thom O'Connor

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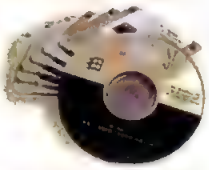

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Read Only

REVIEWS OF THE LATEST BOOKS FOR THE PC USER

Edited by Tin Albano

An Armchair Traveler's Guide to the Web

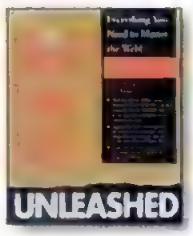
BY DAVID ANGELL

The World Wide Web Unleashed is an impressive armchair traveler's guide to the Web. The key word here is *armchair:* The authors let readers travel the Web only vicariously. And the journey is not always a smooth one.

Organized into six parts, this guide of 1,000-plus pages covers the Web from Unix, Macintosh, and Microsoft Windows perspectives. It starts with an in-depth introduction that covers the Internet, hypertext, multimedia, HTTP (HyperText Transfer Protocol), NCSA Mosaic, and how they all converge to make up the Web.

The Web journey begins to get bumpy in part II, "Web Browsers and Connections." The level of detail is inconsistent with that found in the rest of the book. For example, readers are abandoned at the TCP/IP connection starting gate; the book offers only limited coverage of a topic that's important for any Web user. And the description of Mosaic—the leading Web browser—suffers from the same lack of practical information on setup and use.

Readers will return to a smoother ride in part III, "Web Navigation Tools and Techniques." It's one of the most rewarding sections of this book. The authors offer valuable techniques and tips for surfing the vast, hypermedia world of the Web.



Part IV adds to your Web-surfing techniques by providing an extensive annotated guide to Web sites, covering business, entertainment, art, science, communication, publishing, and more.

Part V, "Weaving a Web," tells readers how to become providers of Web documents. It imparts valuable advice and techniques for planning and designing documents to place on Web servers. The coverage of HTML editors—programs used to create Web documents—includes surveys of the leading programs. The book concludes with a section that touches on broader Web concerns, including the content and quality issues involved with providing information on the Web, conferencing on the Web, and future Web trends.

▶ **The World Wide Web Unleashed,** *by John December and Neil Randall, $35.* Sams Publishing, *800-428-5331. ISBN: 0-672-30617-4.*

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CD-ROMs: Just a Pretty Face?

BY ERYN BROWN

Ready to take the plunge into multimedia? Considering buying your first CD-ROM drive? These two books can help introduce you to the bustling new computer world, where CDs are *the* media.

The Multimedia Home Companion takes advantage of the fun side of multimedia to produce a friendly, attractive "buyers' guide" for the uninitiated. Full of color photos and artfully cropped screenshots, the book guides new multimedia users from square one, explaining in a familiar, easy-to-read style everything from what multimedia is to the differences among current platforms (PC, Macintosh, and dedicated games platforms).

Because the authors are writing for such a broad audience, the amount of attention that can be dedicated to any single platform-specific issue is limited. Nonetheless, the book's CD-ROM reviews section presents a well-chosen catalog of today's best titles.

The second edition of *The CD-ROM Book* is less eye-catching than *Home Companion,* but it shares the other book's easy-to-read style and friendly tone, and it goes beyond the bare basics to offer a more thorough introduction to multimedia. *The CD-ROM Book* is solely focused on CD-ROM technology, and it includes in-depth hardware comparisons (including icons placed next to the best products), a step-by-step walk through the twists and turns of installing a CD-ROM drive into a PC, and chapters on business uses for CD-ROM technology, CD-ROM mastering, networking a CD-ROM drive, and copyright law.

The degree of detail can be overwhelming, but the book is written clearly and accessibly, and you can skip past the parts that you don't want to read and still stay oriented.

For a colorful introduction to titles and a basic introduction to the platforms, buy *The Multimedia Home Companion,* but for the real nuts and bolts that will serve you down the road, check out *The CD-ROM Book.*

▶ **The Multimedia Home Companion,** *edited by Rebecca Buffum Taylor, $21.99.* Warner Books, *800-222-6747. ISBN: 0-446-67039-1.*

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▶ **The CD-ROM Book, Second Edition,** *by Steve Bosak and Jeffrey Sloman, revised by Dave Gibbons, $39.99.* Que Corp., *800-428-5331. ISBN: 1-56529-957-4.*

Circle 445 on reader service card

READ ONLY RECOMMENDS

What looks good on someone else's PC may turn up muddy or even as a blank screen on yours. With its accompanying software, Walt Garnett's *Garbage In, Gorgeous Out* can help you get through the often frustrating tasks of text and graphics conversion. $34.95, Wincrest/McGraw-Hill, 800-822-8158; ISBN: 0-07-911894-1.

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*Tested in a 90MHz Pentium PCI machine at 800 x 600 x 24-bit

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CIRCLE 137 ON READER SERVICE CARD

Michael J. Miller

Where Do I Want to Go Today?

It's a question I find myself asking a lot these days. And as more and more people get connected to the Internet with easier access to World-Wide Web sites, they too will find themselves wondering more often, "Where should I go next?" Here are some of my favorite Web stomping grounds.

Of course, I always start at *PC Magazine*'s own home page (*http://www.ziff.com/~pcmag*). It has a current table of contents, our latest utilities, and extras like Windows Help and DOS text versions of all the solutions tips from the past year. More to the point, *PC Magazine*'s home page includes a lot of links to other places, thanks to executive editor Rick Ayre and our on-line technical associate, Tom Giebel. They choose their favorite new sites and places to look for interesting information. I'm always amazed by what they find.

PC Magazine isn't our only magazine on the Web; all other Ziff magazines are on-line and accessible from the main Ziff home page (*http://www.ziff.com*). I nearly always check out *PC Week*'s page (*http://www.ziff.com/~pcweek*) when something hot is happening.

Two Web pioneers take an interesting approach to their electronic magazines. Hotwired (*http://www.hotwired.com*) includes back issues of *Wired* magazines, as well as command links to other Web places. With its request for registration and its initial advertisements, it's an interesting example of where publishing on the Web is going. For another example, check out O'Reilly & Associates' Global Network Navigator (*http://gnn.com/gnn/gnn.html*). GNN is even starting to take credit cards so you can order merchandise on-line.

DAY TRIPPER

Before you schedule your next vacation, why not go on-line for a little day trip, to check out cities, resorts, and so on before actually leaving the comfort of your own backyard. A few cities are already on-line and more will be adding their own home pages in the near future. Check out Aspen Snowmass On-line (*http://www.aspenonline.com/aspenonline*) for interesting events in Aspen, Colorado. Maybe you could even take a quick stop by San Carlos, California, at (*http://www.abag.ca.gov/abag/local_gov/city/san_carlos/schome.html*) for information on elections, government programs, and so forth. If you're thinking about helping your city or town get on-line, these pages are wonderful models.

You can even visit Washington DC and several federal government sites. If you haven't already, you'll want to visit the White House (*http://www.whitehouse.gov*). You can even download the federal budget simulator from the Bipartisan Commission on Entitlements (*http://www.charm.net/~dcarolco*). But be forewarned: Running this 2MB Lotus 1-2-3 spreadsheet file could be hazardous to your opinion of the federal government.

Doing business overseas? You won't need a travel visa to go to Hong Kong's home page (*http://fareast.com/hongkong/directory.html*) for a list of businesses, hotels, and events.

STOP BY THE LIBRARY

If you already have a pretty good idea of what kind of information you're looking for when you go on-line, visit some of the "virtual libraries" on the Web. These sites act as organized catalogs of information on the net: Some just maintain lists of sites posted there, others list all the different home pages available, and still others organize just about everything they can find available on the net.

You can't go wrong if you start your investigation at the WWW Virtual Library (*http://info.cern.ch/hypertext/DataSources/bySubject/Overview.html*) offered by CERN. The Web started at CERN, and the WWW Virtual Library accessed there is one of the

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Illustration by Steven Salerno

most complete sources of information—it's organized by the Library of Congress classification system, so it's very straightforward.

Another "virtual library," that is arranged by topic, is EINet Galaxy (*http://galaxy.einet.net*) from the Microelectronics and Computer Technology Corporation (MCC). Its arrangement is a little different but still quite interesting. EINet has a basic search engine with simple Boolean operators, which returns a list of documents scored by how close the document seems to your search.

A similar arrangement is offered by Yahoo, a guide to the Web (*http://akebono.stanford.edu/yahoo*). Yahoo, which stands for Yet Another Hierarchically—Officious/Obstreperous/Odiferous/Organized—Oracle, is somewhat smaller, and its search engine isn't as fast as those at other sites. But given all the data on the Internet these days, any search engine can be a blessing.

The best and most comprehensive information source I've seen on the net is the Lycos server found at Carnegie-Mellon (*http://lycos.cs.cmu.edu*). Lycos, which bills itself as "The Catalog of the Internet," has a number of search databases, including 1.5 million URLs. It offers its own sophisticated search language that is a bit slower to use than some others, but it gives back a lot more information, including excerpts of the pages.

Other places you can go to dig for information include the WWW Home Pages Harvest Browser (*http://town.hall.org/brokers/Home.html*), which uses commercial WAIS to access more than 17,000 home pages. It has a great interface and seems quite fast. The WebCrawler (*http://webcrawler.cs.washington.edu/WebCrawler/WebQuery.html*) is also indexed by content.

I recently tried using all of these "virtual libraries" to find information on artificial life, a subject I find quite interesting. Just about all of them directed me to the Santa Fe Institute's bulletin board on artificial life (*http://www.santafe.edu*). But just by looking around some of the other suggested sources, I found myself at neat places, such as home pages on the subject offered at UCLA and other universities. I found all sorts of great documents, events listings, and even downloadable software. But I digress. Then again digression is one of the things that seems to define the Web, and perhaps the Internet in general.

WHEREVER YOU GO, THERE YOU ARE

Sometimes the best way to understand a new place is just to wander around. In case you want to go to a random place, a couple of Web sites make it easy to lose yourself in the Net. You never know where you'll end up, but that's the fun. URouLette (a play on URLs, the name for Web addresses) at the University of Kansas is one such site (*http//ukanaix.cc.ukans.edu/cwis/organizations/kucia/uroulette/uroulette.html*). Just click on the spinning wheel and take your chances—you never know where you'll end up. The last time I tried, I wound up on a home page discussing photonic processing. An alternative is Stanford's Yahoo page; choose an option that will take you to "A Random Link." When I last tried that, I was sent to an MIT page showing pictures of Caribbean islands.

As I write this, it's cold and wet in New York. Maybe the Caribbean really is where I want to go today. □

GUIDE TO ELECTRONIC EDITIONS

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Forums: Visit Bill Machrone's discussion area (GO EDITOR) to tell him what you think of his new Second Looks column.

Downloads: Our featured utility, 1MBFORT, solves insufficient low memory problems in Windows applications. (GO FREEUTIL) Also available: the Internet front end, Pipeline (GO EDITOR or EXEC)

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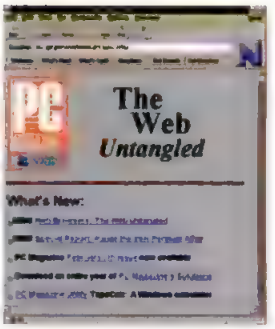
PC Magazine On The Web

Visit us at http://www.pcmag.ziff.com/~pcmag

Columns: "Where Do I Want To Go Today?" Connect with Editor-in-chief Michael Miller's list of great places to get started on the World-Wide Web (see above).

Downloads: Featured utility: 1MBFORT solves insufficient low memory problems in Windows applications. Also available, the Internet front end, Pipeline.



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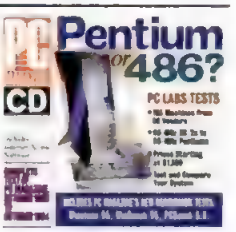

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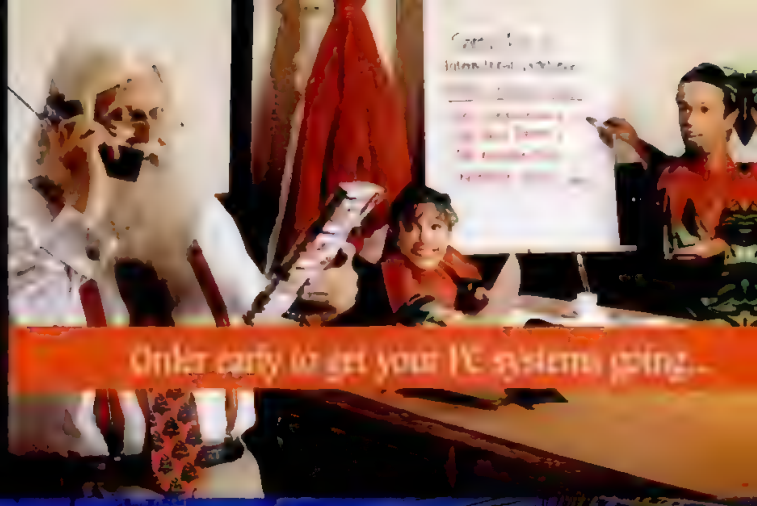

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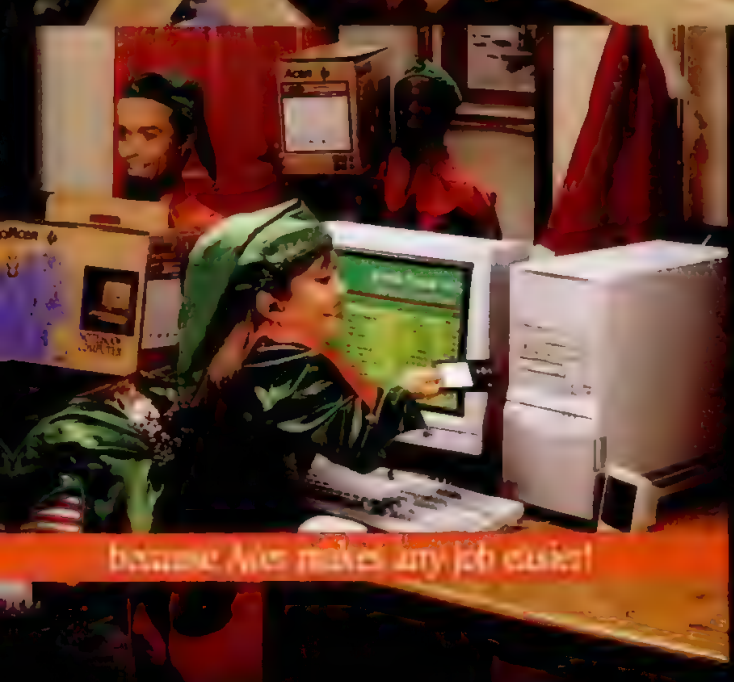

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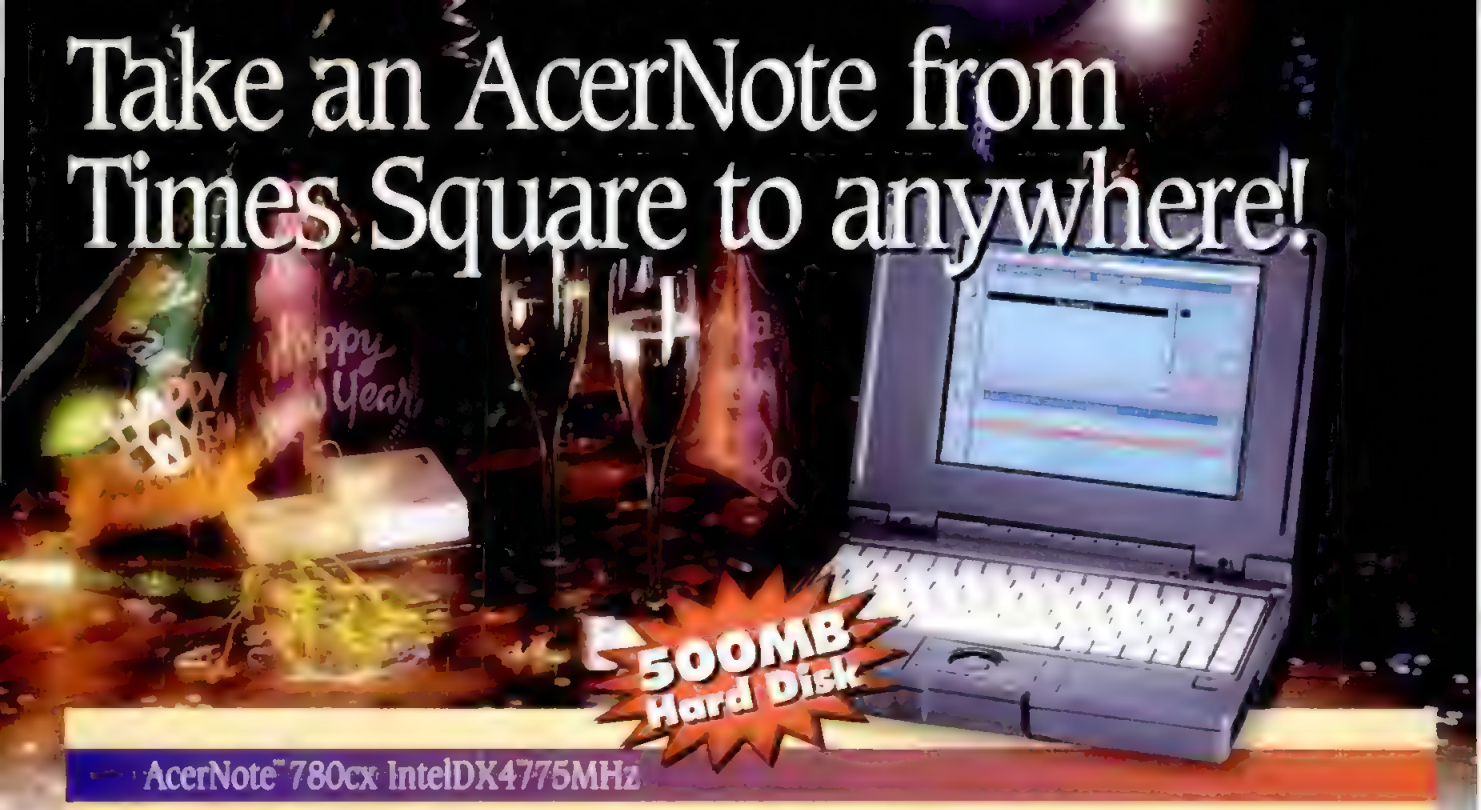

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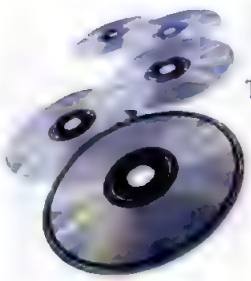

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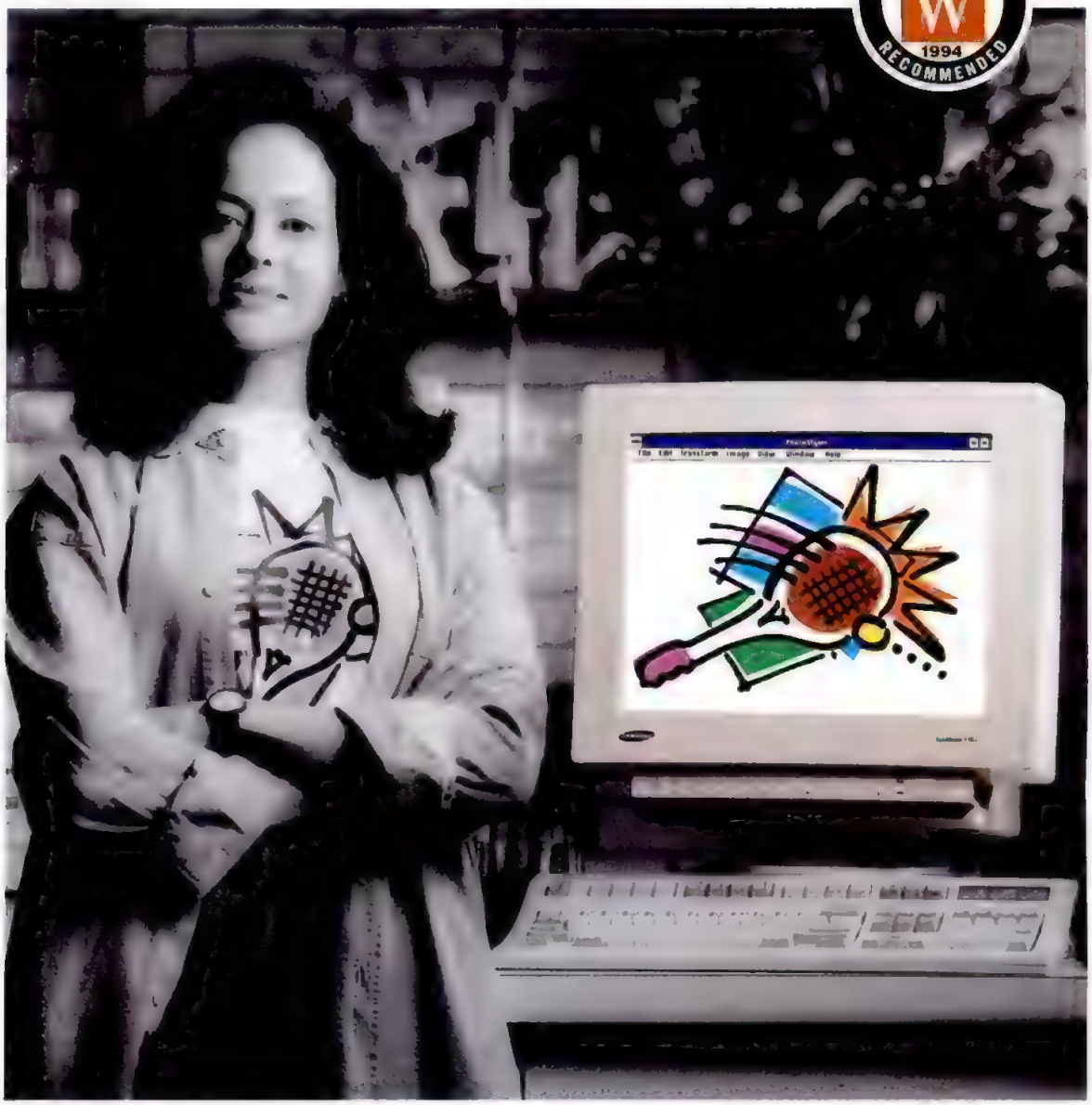

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Bill Machrone

Where Everybody Knows Your Name

No one knows exactly how many bulletin board systems there are in this country, but they number in the thousands. One thing's for sure: They're undergoing some major changes. They started out as an inexpensive way for early computer users to communicate and share their work, since in those early days you often had to write your own BIOS and driver software.

BBSs sort themselves into four general types. The first serves a local, geographic constituency. Such BBSs are typically free but may be run to benefit a club or group.

The second type is the commercial BBS. These systems are attractive because they have critical mass. They've got gigabytes of downloadable files, both shareware and freeware. Enough people use them so that the chat sessions are interesting, Fees are low: $10 or $12 per month. Small boards charge half as much.

BBSs of the third kind are run by businesses. The computer industry is the most visible of these, providing technical support, updated drivers, and product information. Other BBSs are run by marketing departments to collect and disseminate sales statistics, accessed by customers to check inventory and leave messages, and used in dozens of other ways where a private, inexpensive computer link is the best solution to a business problem.

The fourth type is the special-interest BBS. These run the gamut from game-intensive forums that match you with competitors from all over the country to cerebral, developer-oriented boards devoted to a programming language. They may be .GIF-heavy boards crammed full of adult images or steamy chat lines, each promising that their patrons are the hottest, randiest adults on the planet.

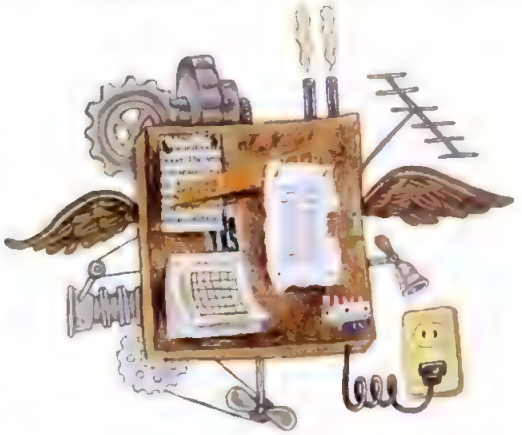
Several publications devote themselves to this market, chief among them Jake Richter's *Boardwatch* (800-933-6038, *subscriptions@boardwatch.com,* or *http://www.boardwatch.com).* Most of the boards now offer the same new service: Internet access. In addition to the usual attributes—129 lines, 18GB, lots of porn, no porn—BBSs are now listing access to Usenet, IRC (Internet Relay Chat), Internet mail, and SLIP.

Like the BBS world in general, these Internet services are based on ASCII characters, although many boards support RIP (Remote Imaging Protocol). RIP is a method that lets you put up graphical screens and images complete with buttons and scroll bars. RIP is tuned to the relatively low speeds of modems: It's fast, colorful, and effective, but it can't touch the resolution of bitmapped screens or the embedded .GIF and JPEG images you find in World-Wide Web browsers. Of course, those big graphics files take a long time to arrive by modem; there lies the balancing act that will mark the future of BBSs.

They've already got Internet access, so it's likely that users will want BBSs to become full Internet access providers. That means access to the Web, FTP, and Gopher, which require faster lines from the BBS to the Internet. BBS operators can provide graphical browsers such as Mosaic and Netscape Navigator, or they can host browser sessions on their own hardware and provide remote Windows access via Galacticomm's new Windows-based BBS software, code-named Project Victory (800-328-1128).

The question is whether the BBS remains relevant in the burgeoning age of the Internet. All the big sites offer the same shareware files and .GIFs and have vendor support (which is impossible on the local level). Conversations and discussion groups that depend on expertise and experience benefit from wider exposure. Will users want separate local and global conversations?

Ultimately I think the biggest Internet newsgroups will simply collapse under their own weight. People will prefer their local BBS, a place like Cheers (where everybody knows your name)—even if the local BBS becomes a Web site.



Local BBSs are going global to remain relevant in the brave new on-line world.

Illustration by Carolyn Fisher

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CIRCLE 105 ON READER SERVICE CARD

Bill Machrone

Second Looks

LIVING WITH THE PRODUCTS WE REVIEW

Welcome to Second Looks, a hands-on column focusing on the realities of living with and using high-profile hardware and software products. I'd like to hear your experiences and share the pinnacles, pitfalls, and practicalities of these products.

Monkey Wrench for Microsoft Works

When *PC Magazine* reviewed the integrated software product Microsoft Works for Windows, Version 3.0 (First Looks, February 8, 1994), we were impressed by its ability to fit a lot of power into a small package as well as by the fact that it could work with many standard file formats. But since that time, users have flooded Microsoft's forum with problems in converting files to and from Microsoft Word for Windows, Version 6.0.

Several users found themselves in the unenviable position of bringing home a Word 6.0 file of a memo or letter to polish over the weekend only to receive file conversion errors when the time came to save the document. Others had trouble opening Word 6.0 files in MS Works. I think that the blame should be shared between the two products: The conversion software for MS Works 3.0 was written before Word 6.0 was actually finished, and Word 6.0 has some formatting bugs of its own.

The easiest solution to each translation snag is to open and save the files as Word 2.0 or Rich Text Format (RTF) documents and hope that most of the formatting is faithfully converted. A more elegant solution is to use the updated code that is incorporated into Version 3.0b of the product, which is presently shipping.

Those with older versions of MS Works should download the software patch from Microsoft's Works Forum file library on CompuServe, which also contains instructions on how to install the patch.

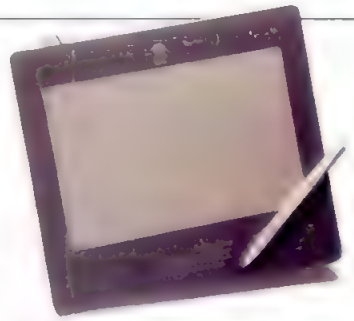
Does Number Nine's Imagine128 Do DOS?

Our initial review of Number Nine Computer Corp.'s video card Imagine128 (First Looks, January 10, 1995) showed it to be among the most capable Windows accelerators we've seen. DOS performance, however, was dismal. It was quite disheartening to be informed that I had to cut back on resolution when installing the demanding DOS game Under a Killing Moon despite having one of the hottest Windows video cards around.

The problem is that the Imagine-128's architecture was designed for the sole purpose of speeding up Windows; it is not fundamentally VGA-compatible. Such trade-offs are not unusual: Matrox's speedy MGA chip turns in lackluster DOS performance, for example. VGA compatibility for MGA-equipped products is provided by a separate chip, so you really have two video cards in one.

This incompatibility also came to the fore when I attempted to use the Imagine128 with OS/2 Warp. Until Number Nine delivers a Warp-compatible video driver, you're stuck with 640-by-480 VGA resolution. All the while, you'd never know that 4 unusable megabytes of video memory were just inches away. Number Nine does have a Warp driver in the works, promised for later this year.

How to contact Second Looks: On ZiffNet type GO ZNT:EDITOR, and choose Views: Machrone. Contact Machrone directly via MCI Mail at Wmachrone or CompuServe at 72241,15. You can also find us on the World-Wide Web at *http://pcmag.ziff.com/~pcmag.*



Is It Dell's Problem. . . Or Mine?

My Dell Dimension XPS P90 had a problem that seemed to be a hardware bug. After I used some Windows-based comm programs, the system would lock up. Early versions of the Intel-designed motherboard had a fault that caused system lockups during serial communications, but this problem was of my own making.

The culprit was CIC's Handwriter for Windows pen tablet, which installed Windows for Pen Computing on the PC. When I was done with Handwriter, I reinstalled Microsoft Windows for Workgroups, but it didn't replace all the files.

The snag was a DLL that expected to find the tablet on the serial port. The only fix was to reinstall Windows—uninviting with about 500MB of applications. Adventurously, I installed WfWG to a new directory, \wintemp, and then copied all the files to \windows and \windows\system.

Be warned: If you try this, you may have to reinstall any TrueType fonts and programs that add sections to WIN.INI. □

LOOKING AHEAD

Tell me what you love and hate about these products and we'll share the information in future issues.

Autodesk 3D Studio	Quicken for Windows
IBM ThinkPad 755CD	Vertisoft Remove-It
LANtastic for OS/2	Toshiba Portégé T3600CT
Lotus Organizer 2.0	WordPerfect 6.1
PCMCIA modems	ZDS Z-NoteFlex

Photograph by Thom O'Connor

NPR® CHANGED

If there is one thing we all have in common, it is a need to express ourselves. For some folks in Wyoming that need gets met every time they tune in to National Public Radio's® *The Thistle & Shamrock*® show, which airs Saturday evenings on Wyoming Public Radio. (That's 91.9 on your FM dial.)

Now aside from having a need to express themselves, NPR also has a rather urgent need to be heard. Which begins to explain why they're such keen users of Microsoft® Word 6.0.

You see, NPR is all about intelligent communication. So it stands to reason that they'd use an intelligent word processor. Especially if they were trying to do something like show the station that a Celtic music program could be the biggest thing to hit Chugwater since the blizzard of '69.

For such a job they'd surely want to add charts and graphs. They'd want to drag stuff from one document and drop it into another. They'd want automatic formatting. They'd want to whip up a table of contents. Simply put, they'd want to make their point so well that the station's staff would be happy to change their programming. And why shouldn't they be? NPR already knew how it would make their listeners feel.

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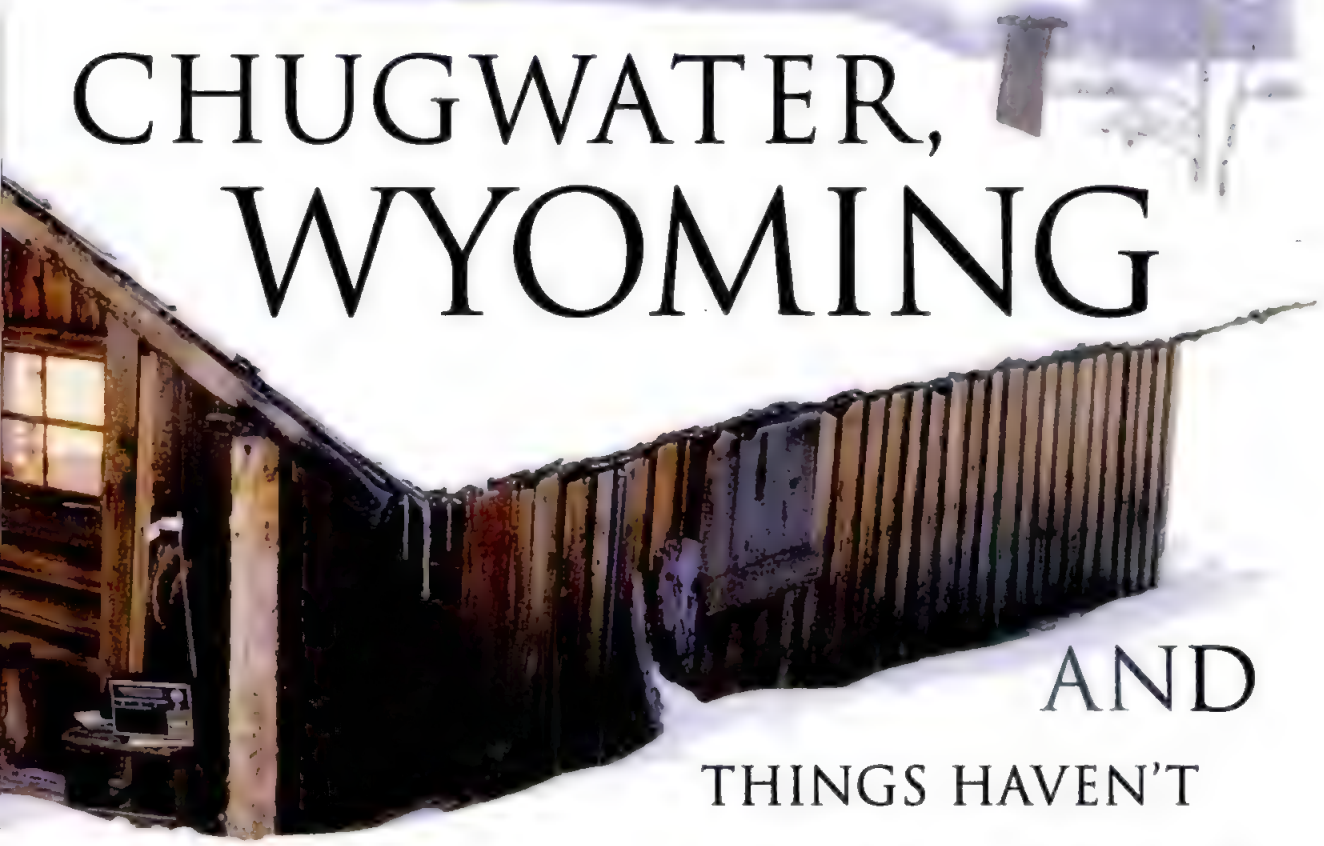

AND THINGS HAVEN'T BEEN THE SAME SINCE.

Of course we're not going to say Chugwater would have turned into a cultural wasteland if it weren't for *The Thistle & Shamrock* show. We're just saying that the more clearly you get your point across, the more likely it'll be heard. (Something to think about next time you're looking for a raise.)

And now for a word from our sponsor: If you'd like to hear a little more about Microsoft Word 6.0 or any of the other fine products that make up Microsoft Office, just give us a call at (800) 240-4782, Department NEC. We're pretty sure you'll be impressed with the reception.

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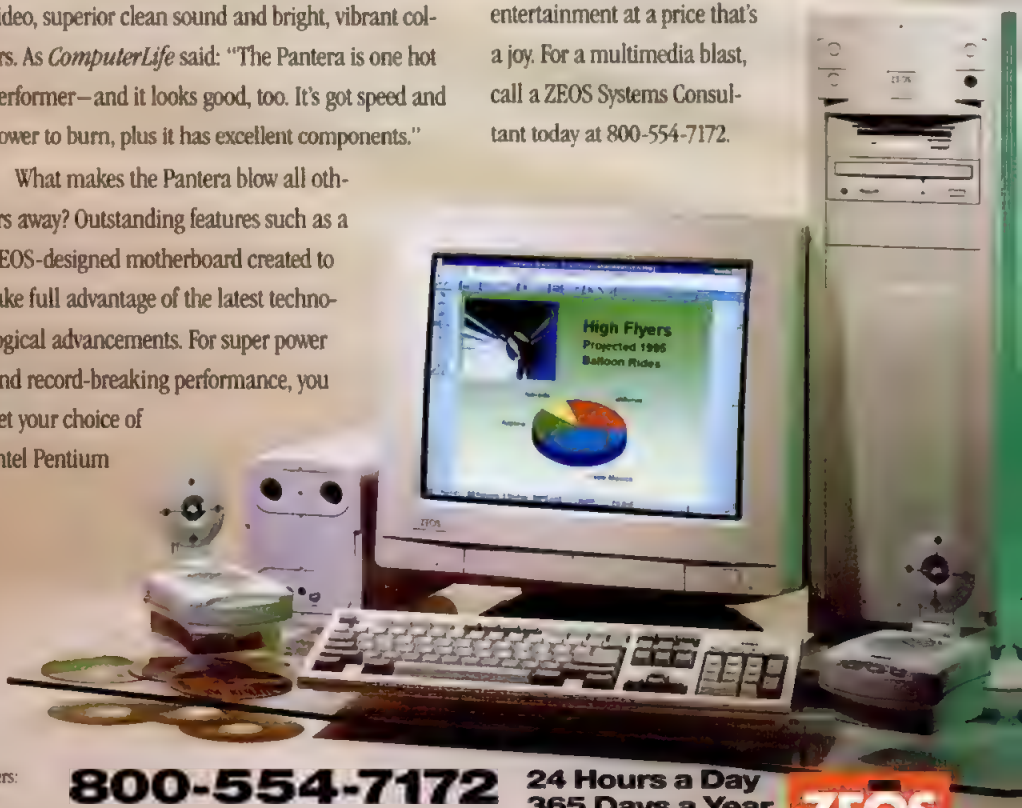

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CIRCLE 125 ON READER SERVICE CARD

John C. Dvorak

Info Overload at Your Fingertips

Most people who have followed the communications scene and the Internet have a sense that the supporting structure is about to collapse, leaving us with a mess unlike anything we've seen since the Atari game market bust a decade ago. The current situation is a disaster waiting to happen.

The Internet and all the on-line services are experiencing an amazing boom for no particular reason except that veep Al "Ozone" Gore popularized the term *information superhighway*. So we now have a growing mess unlike anything ever imagined. Let's face it: Only a very few people have any real need for on-line services such as AOL, CompuServe, Prodigy, or the entire Internet system and World-Wide Web. But because the scene has suddenly become so hip, everybody is jumping on the bandwagon.

Tons of Internet books are sold and software is downloaded. What do you end up with? Well, one of the editors at *PC Magazine* showed me his system, and on his browser menu he has a hyperjump that takes him to the web server at his old college. There, he can get the menu for the school's cafeteria. "Look," he says with glee. "I can see what's for lunch. Isn't that neat!" Is it?

In fact the Internet probably should be completely shut down tomorrow for productivity reasons. People are spending—or rather *wasting*—too much time looking at amateur photos of juniper trees: "They're in J.D. Salinger's backyard! Isn't that neat!" Or they're wasting time hanging out on the IRC, the Internet Relay Chat, which—like CompuServe's CB and AOL's People Connection—is a real time sink.

But time consumption is not what will stall the Internet; it's the false promises. Here are the three big ones:

1. Information at your fingertips. Horse puckey. What information there is is scattered all over the place. Can you read the front page of *The New York Times*? No. Can you get all the text from *PC Magazine* to read? No. Most of what you can get is academic, and it's an uncataloged mess. When you do get information, it's likely to be old, useless, or too disorganized to be of much use.

2. The World-Wide Web (the Web, WWW, or W³ for short). This graphical subsystem is the hot ticket in the Internet world. The problem here is that the information is not controlled, so it's as easy for some hate group in Idaho to post creepy propaganda as it is for a church in Anaheim to put up a Web page selling a miracle ointment. My experience poking around Web sites indicates a bigger problem: Web pages and Web sites that aren't maintained. The data is months old, and file transfer is buggy—it's a joke.

3. A bigger joke. Then there are the hopeless bug-eyed business folk who think putting their company on the Internet is cool. "Hey, we can do all our business over the Internet. Neat, huh!" Sheesh. Once a hacker wrecks the server or a secret corporate memo leaks to the Associated Press, they'll rethink using such an open system for conducting sensitive business. Beware: One underground group of hackers has already declared war on anyone who expects to exploit the Internet for corporate use.

Combine all the scenarios of time wasting, money wasting, information overload, Web hackers, and false promises and the Internet could take a serious tumble. We'll someday look back on the Internet sycophants and ask, "Gee, how did all those dinky companies think they could make money? Were they nuts?"

The Internet probably should be completely shut down tomorrow for productivity reasons.

Right now the scene reminds me of the network-computing nuttiness of a decade ago. It managed to last through a shakeout, though, unlike the video game scene. And, of course, video games didn't die with the fall of Atari but returned in an improved form. Whatever happens, on-line computing is not going to go away altogether, but disappointment lurks.

Illustration by James Steinberg

A product with one of the highest *"You're kidding me"* scores ever recorded.

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John C. Dvorak

Inside Track

It's interesting to watch Intel **turn up the heat** on the P6 project. According to reports, the chip **suffers** all the problems of **size and heat** of the Pentium (P5), but Intel is rushing to get this chip to market even before the Pentium has achieved much market penetration. The potential for another disaster of the scale of the Pentium floating-point PR debacle is increased by this haste. It also lessens the cash-cow potential of the Pentium. Rushing a product to market is nothing new, but I believe Intel's rationale has changed significantly.

Intel brings out new chips to thwart competitors' 386 and 486 clone chips. There is a rumor that AMD's K5 will easily outperform the Pentium—but the K5 is not going to be shipping in quantities so soon that Intel has to rush the P6 to market.

Historically, Intel has brought out its next generation of chips to **thwart AMD** and other competitors riding on Intel's coattails with 386 and 486 clone chips. There is a rumor in the Valley that the AMD K5 (the company's Pentium alternative) is a screamer that will easily outperform the Pentium, and one can assume that this is a matter of some concern to Intel. But the K5 is not going to be shipping in quantities so soon that Intel has to rush the P6 to market.

A bigger threat comes from the new player, Apple/IBM/Motorola's PowerPC—specifically **the 604** and the chips to come after. Right now, the 100-MHz 601 is on a performance par with the 100-MHz Pentium. The 604, which is twice as powerful on a megahertz-per-megahertz basis, will show up in machines this March! These chips are so powerful, small, and economical that the Intel architecture cannot compete with them forever (despite the installed base of existing software).

Hence, there is evidence that Intel is completely abandoning the *x86* architecture after the P6; it will instead move to an architecture codeveloped with Hewlett-Packard that relies on many aspects of HP's PA-RISC design. An attempt will be made to make this new "PA-RISC/86" design compatible with the old code—**a dubious achievement.** Intel hopes to make the old designs (especially the clone designs) totally obsolete and keep control of the market. Until then, we can expect a push towards multiple processors as the best way to boost performance.

Complaining About Microsoft Dept.: The Microsoft juggernaut rolls on, and various software companies are still complaining to the Justice Department. I'm amused at how they all must remain anonymous, as one report put it, "out of fear of retribution." What can Microsoft do to them? And if they retaliate, isn't that proof of unfair practices? Apparently the government can't figure that one out. One example: It's well known that Novell has barked about Microsoft practices. So in retribution, Microsoft stuck Novell with Microsoft Money in the same deal that brought Intuit and Quicken to Microsoft. Now that's **retribution.**

Meanwhile, Microsoft is trying to get a foothold in, and then gain **control of international banking,** according to one source. "Why not? It's mostly software nowadays," says the source. Intuit and the Microsoft Network, combined with Uunet (the Internet provider), add up to a combination that will send me to a small local bank for sure. "I don't want Bill Gates looking at *my* checking account," a friend commented. I figure he will anyway, since we could all be working for him shortly.

Amusing Comment Dept.: Michael Dell, head honcho of Dell Computer Corp., said the other day that he hopes to see the computer industry's general attitude change from "technology elitist" to a more consumer-oriented approach. Yeah, sure. How is this supposed to work when you can't get a sound card installed without knowing about DMA channels and IRQ settings? These details are not things people should have to consider. Talk is cheap when it comes to making the perfect consumer computer.

Genuinely Interesting Software Dept.: Over the years I've tried a lot of different viewers for .GIF, .PCX, and TIFF files, but I always go back to the same one: VPIC from Bob Montgomery. It works with 95 percent of the graphics cards out there, and it works flawlessly. The next version will include a JPEG viewer, which is the only thing missing. JPEG has caught the graphics community a bit flat-footed, as it's turning into the preferred method for saving images. A 25K .GIF file, for example, will boil down to about 6K in JPEG format. You can't tell the difference when the image is viewed. VPIC is a DOS program that bypasses the Windows video drivers so it is incredibly fast. It's $30 (shipping included) from VPIC Inc., Box 162857, Altamonte Springs, FL 32716. Call or fax them at 407-869-5233.

Another **great viewer** comes from the Yee brothers in Boston. There are two versions, one for OS/2 and one for Windows. The OS/2 PM version—PMJPG—is $20, and the Windows version—WinJPG—is $25 (plus $4 shipping in the U.S., $8 overseas). Both do JPEG as well as the normal array (.GIF, TIFF, .BMP, and so on) of file viewing and tweaking. The program even creates a batch file of image files and converts them all to JPEG. This is an outstanding product with an excellent look and feel. If you're interested, contact Norman or Ken Yee, 58 Chandler St., Boston, MA 02116 (617-423-2399). You can also reach them via the Internet at *nyee@osiris.ee.tufts.edu* or *kenyee@ksr.com*. □

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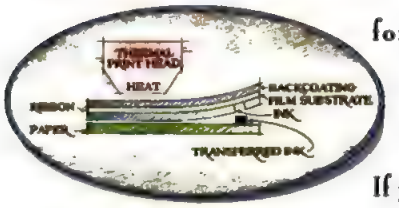

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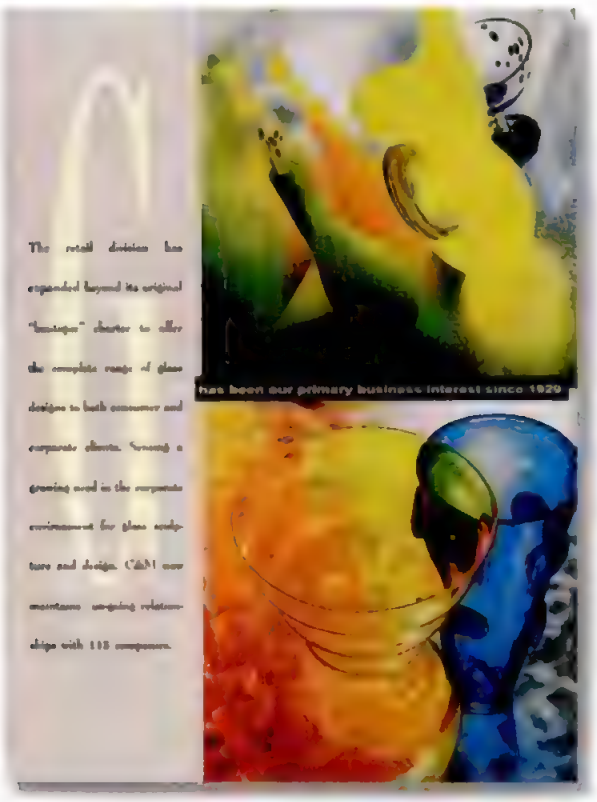

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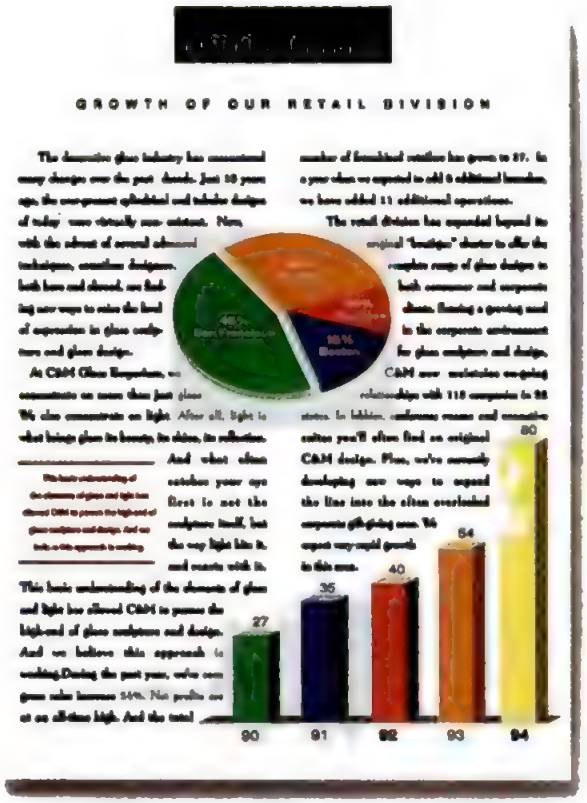

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The Software-Patent Ambush

Our lives may have been improved by using PCs, but the no-pain-no-gain rule still holds. And one of the biggest pains is dealing with the increasing complexity of the world of computers. Witness the CompuServe/Unisys brouhaha at year's end over royalty claims on a Unisys data-compression patent.

The story unfolded on-line and in the newspapers. On December 29, CompuServe Information Service (CIS) dropped a bomb on the on-line world—and on software developers in general. It demanded that developers agree by January 10 (just 12 days later) to pay CIS royalties on subsequent sales of software using the CIS-developed graphics interchange format, which is more commonly known as the .GIF file format.

The background of this battle in the making is important. CIS developed the .GIF format in 1987 and has promoted it ever since as an industry standard for 256-color raster graphics files. It worked—GIF is probably the most widely used file-exchange format for graphics. In all that time, CIS never said a word about royalties.

UNWITTING INFRINGER

Because, as it turned out, CIS was itself an unwitting patent infringer. CIS's programmers had based the .GIF format on the widely used Lempel-Ziv-Welch (LZW) data-compression algorithm. But Sperry, the predecessor to today's Unisys Corp., had received a software patent for the LZW algorithm in 1985. CIS had been infringing on Unisys's patent for seven years. And by definition, every program that read or wrote GIFs was also in violation.

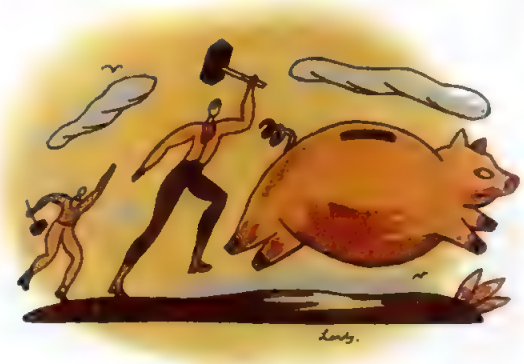
Unisys contacted CIS in January 1993; the two companies took a year and a half to work out a licensing arangement. As part of the agreement finalized last summer, CIS paid Unisys a reported $125,000. CIS also claimed it had the right (but not the obligation) to demand sublicense royalties from anyone who had ever put out a product that read or wrote .GIF files.

With exquisite timing, CIS announced its demand for royalties four days after Christmas. Beyond its broad claims, CIS also endeared itself to software developers with the gun-to-the-head routine: If developers wouldn't agree to the company's demands by January 10, they would face legal action by CIS to collect back royalties on copies of every program they had ever sold that dealt with .GIFs.

Is CIS being mean-spirited? Maybe the company just forgot about the year and a half it took to work out its deal with Unisys, plus the six months it took to spring this trap on the developer community. Finally, CIS's nasty little license covered developers' use of LZW/.GIF only in code intended primarily for use with CompuServe. Other uses might still require direct royalty arrangements with Unisys.

The on-line community exploded. CompuServe's own graphics forums filled up with angry messages; software developers shot back "hell, no!" manifestos; *The New York Times* and *The Wall Street Journal* jumped on the story; and the Internet—filled with .GIFs and .GIFfy software—went absolutely crazy over this attempt to charge for something that everyone had rightly thought was in the public domain.

Both CIS and Unisys professed to be surprised by the volume and intensity of the response. Sleepy Unisys, unaccustomed to the size and rapid communications of the PC community and the intense and intimate world of the Net, probably was astounded and later backed down. It said it would pursue "inadvertent infringement." Unisys made it clear that CIS had acted on its own and said it would make no claim for royalties for Internet and other uses of the LZW algorithm in applications released before 1995.



Software patents are a viable and probably essential form of protection for intellectual property.

Much of the heat since CIS made its original demands has focused on name calling and finger pointing. That part is easy

Illustration by Philippe Lardy

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CIRCLE 189 ON READER SERVICE CARD

Jim Seymour

to untangle. Unisys behaved reasonably, and CIS behaved grotesquely. But more interesting is what may remain hidden in the dark and dangerous closet of software patents and hidden in the new world of nearly instant communication on the Internet.

PATIENCE ON PATENTS

Over the past year or two, others here at *PC Magazine* have weighed in with their opinions on software patents. Most of my colleagues hate them and think they're a destructive force. I disagree.

Software patents—when carefully considered, wisely granted, and equitably administered—are a viable and probably essential form of protection for intellectual property. But software patents aren't like patents on mouse traps and radiator caps. We need a new approach to reviewing software-patent applications because the ghost of the now-overturned Compton multimedia patent, which covered anything that moved, haunts us still. We also need a mechanism for avoiding the kind of "patent ambush" that CIS and to a lesser extent Unisys engaged in.

When a software-patent holder jumps out from behind a bush after years of silence, we must assess the holder's ownership and husbandry of the patent over the intervening years. In an industry that evolves as fast as the PC software business (and in cases such as software, where the technology is hidden in compiled code), it is simply unacceptable to bring these post facto claims against companies that have acted in good faith, using what was universally perceived to be public-domain code in their products.

Many who rail against software patents do so because they claim software patents go beyond protection and can actually stifle innovation. That may be the case, but I simply claim they impede ordinary, rational commerce if used in this manner.

Moreover, a lesson first learned in Intel's Approxium debacle is how quickly issues can come to a boil when a few million well-informed people who perceive themselves as stakeholders meet daily on the Internet.

If not for the Net, both a forum for spreading word of the CIS/Unisys mess and a vehicle for pouring gasoline on the fire, CIS might have gotten away with its ambush.

Those days are over for good. Seller, beware. □

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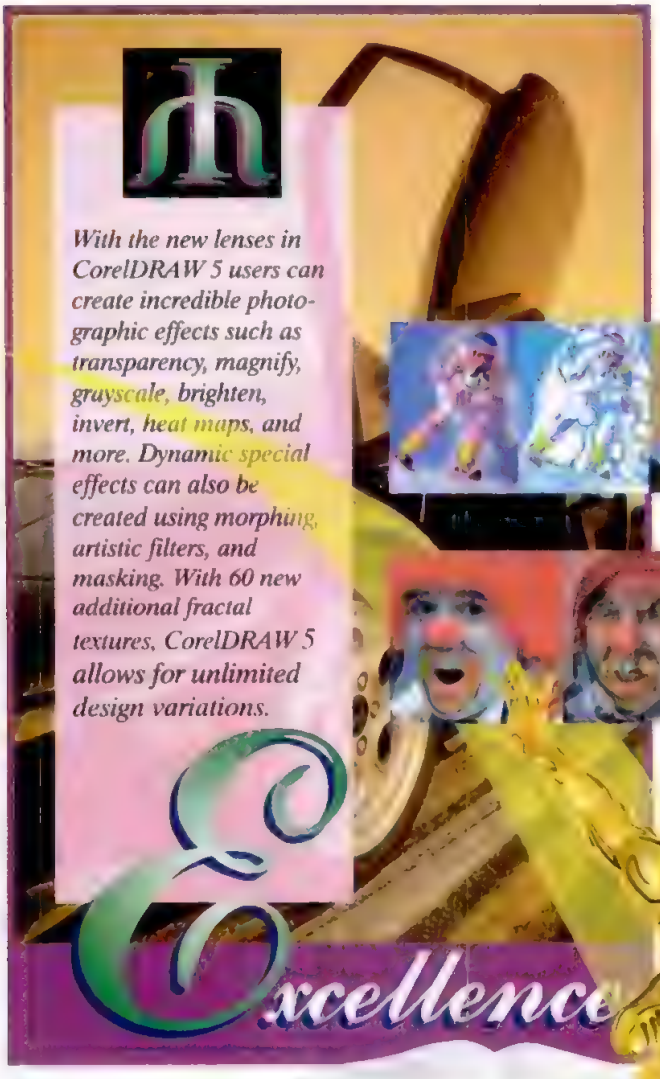

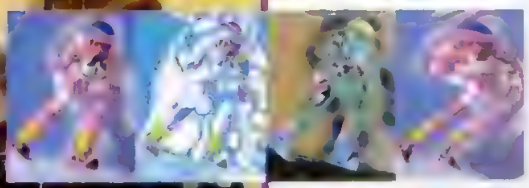
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CIRCLE 170 ON READER SERVICE CARD

Bill Howard

The Gateway Phenomenon

It happens like clockwork: Every time Gateway 2000 earns an A on our Readers' Report Card for Service and Reliability, a torrent of letters and electronic mail comes pouring in from disgruntled readers who've had bad luck with Gateway PCs.

They can't *believe* what they have read. "Just try calling Gateway's 800 number. It's impossible," says one reader. "Fax Gateway a question and then wait a minimum of five business days for an answer," says another.

The same thing happened when we awarded Packard Bell an Editors' Choice in our review of home PCs ("What Goes into a Great Home PC?", *PC Magazine*, December 20, 1994). "If Packard Bell has a mission statement," says one unhappy customer, "it must be: There's a sucker born every minute."

Though we get complaints about every vendor, Gateway 2000 and Packard Bell seem to generate a disproportionate amount of reader ire. What gives?

PROOF IS IN THE POLLING

Because we believe reliability and customer support are so important, we poll *PC Magazine* subscribers to ask about their experience with service and reliability. A questionnaire goes out to 17,000 randomly selected subscribers, and in our last survey we received 2,000-plus responses for Gateway PCs, which is more than enough for us to believe the results aren't a statistical fluke. (For national political polls, a sample is often 1,000 persons.) In each of the past five surveys we've done, Gateway has ranked above average on all three key measures of satisfaction: reliability, repair service, and technical support. So somebody out there likes Gateway.

But I do have friends who've been burned by Gateway technical support, repair service, and compatibility woes. Many of them. And they have interesting stories to tell. A good friend was shipped an SX CPU rather than a DX, the monitor failed, and the hard disk was smaller than promised. It took him forever to get through to tech support, but eventually he got each problem corrected, and Gateway forgot to take back the old hard disk, so he figures he's ahead of the game.

Gateway's problem isn't that nobody there cares about users. It's that the company's sales have grown faster than its support structure. Gateway is like a growing Saint Bernard puppy that means well but still bumps into tables and knocks over your good china.

PERFORMANCE ISN'T EVERYTHING

Packard Bell has earned a grade of E on our last four surveys, and its PCs are seldom top performers. So how did it manage to get an Editors' Choice award? The company has learned from its near-death experience (product returns two years ago were approaching 20 percent of sales), and it now has the industry's best out-of-box experience. Every cable on the system is color-keyed to match the socket it plugs into. Plug in the connector and the back panel flexes a bit more than on other PCs. You wish it didn't flex, but so what? Overengineered products add cost, and Packard Bell has mastered the fine line between cost cutting and maintaining product integrity.

The reason we liked Packard Bell—despite its past reputation—is that in addition to the great setup, it has a tremendous software bundle. Users say they want quality, but they really want quality and quantity, and with 27 bundled programs, a Packard Bell PC is a great bargain.

There are about a dozen PC brands that I would happily recommend to friends who are setting up PCs in their homes or small offices. I like Dell, Insight, Micron, and ZEOS International among direct-only vendors. I also like Acer, AT&T GIS, Digital, IBM, and NEC. There are others I like, but most users can't go wrong with these recommendations. □

Why do our readers hate (and love) Gateway 2000 and Packard Bell so much?

Illustration by Tom Garrett

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Multimedia *à la Carte*

Mix and match these CD-ROM drives, sound boards, and speakers. PC Magazine Labs tests more than 75 multimedia peripherals.

By Leon Erlanger

You can't put off that multimedia upgrade any longer. Not when CD-ROM versions of mainstream business applications like Lotus 1-2-3 and Paradox for Windows come with multimedia help, when Harvard Graphics and Lotus Freelance for Windows let you add sound and video to your slide presentations, and when thousands of multimedia reference and education titles are available only on CD-ROM.

The easiest solution is to replace your underpowered system with a multimedia PC. In our upcoming May 30th issue, PC Labs will test more than 50 Pentium systems preconfigured with CD-ROM drives and sound boards.

If your existing PC has enough power for multimedia—we recommend at least a 486 with 8MB RAM, a 540MB hard disk, and a Super VGA dis-

CD-ROM Drive

At least double-speed
Double-speed drives will run today's games and edutainment CDs. Quad-speed drives are ready for future applications.

Internal or external
If you want to move your drive between systems, or if you've run out of drive bays, go for the more expensive external model. Otherwise, go internal.

Caddy or caddyless
Frequent disk swappers should consider caddy-based drives.

Manual controls
To let you play audio CDs without running software.

Mini headphone connector

Memory-conserving driver
Look for a driver that loads into high memory or uses about 20K of conventional memory.

Multisession Photo CD
Photo CD lets you store digitized photos on CD; multisession lets you add photos in multiple sessions.

Speakers

Right- and left-channel speakers
Separate speakers allow flexible placement for optimal sound quality.

Woofer/midrange and tweeter in each speaker
The two produce better sound than a single full-range speaker.

Built-in power amplifier
Usually 5 to 10 watts per channel for individual use, 10 to 20 watts per channel for presentations in small boardrooms.

Headphone jack

Separate bass and treble controls
For fine-tuning sound.

Balance control

Volume control

Separate subwoofer
For better bass response.

Magnetic shielding
Prevents interference with the monitor and the hard disk.

Two or more inputs
For mixing sound from more than one source.

Display: 15- or 17-inch monitor, local-bus graphics adapter
Good Windows performance depends on fast video updates, which you are most likely to get using a PCI or VL-Bus graphics adapter. Windows users will find that anything less than a 15-inch monitor produces eyestrain; a 17- inch monitor lets you work with more windows on your screen.

Sound Board

16-bit, 44.1-kHz stereo sampling
A 16-bit sampling size and a 44.1-kHz sampling frequency are necessary to achieve genuine CD-quality sound recording and playback.

Line-in connector
Takes in analog audio from an external CD-ROM drive, cassette deck, or similar source.

Line-out connector
For connecting powered speakers or headphones.

Microphone connector

Variable line-out connector
For nonpowered speakers. We recommend powered speakers.

Drive interface: IDE or SCSI
If the interface on your CD-ROM drive does not match the CD-ROM interface on your sound board, you may have to purchase a separate adapter card to install the drive. ATAPI IDE interfaces let you attach the drive directly to a standard IDE interface on your motherboard. SCSI interfaces let you daisy-chain up to seven SCSI devices.

MIDI/joystick port
To control joysticks and MIDI devices.

Power amplifier
Most produce only 2 watts per channel or less and degrade the sound.

Analog audio connector
Connects by cable to the analog connector on your internal CD-ROM drive for playing audio CDs.

Wavetable synthesis chip
Wavetable MIDI sounds are more realistic than those of FM synthesis.

Digital signal processor chip
Can be programmed for different tasks, including acting as a fax modem.

General MIDI compatibility
Ensures that you get the intended instrument sounds when you play MIDI files.

Creative Labs Sound Blaster compatibility
Required for most DOS games.

Compression
Required for making .WAV files of manageable size on your hard disk. ADPCM, A-Law, and μ-Law are common standards.

System: 486 or Pentium PC
Multimedia applications demand lots of CPU power and storage space. While the MPC spec specifies only 4MB of RAM and a 130MB hard disk, we strongly recommend at least 8MB of RAM and a 540MB hard disk in order to run Windows applications satisfactorily.

Illustration by Rob Doyle

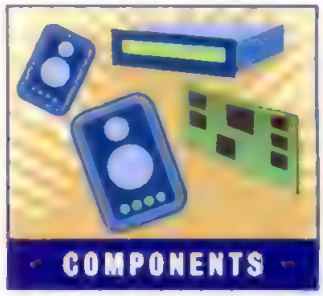
play—you can purchase a multimedia upgrade kit, which usually consists of a CD-ROM drive, sound card, speakers, and some CDs to get you going. Our article "Moving Up to Multimedia" (October 25, 1994) gives the Ziff-Davis Labs test results for 16 kits.

Since many users don't want to be limited to a vendor's preconfigured solutions, PC Labs has rigorously tested each component on its own. The total came to 30 CD-ROM drives, 29 sound boards, and 20 pairs of powered speakers.

À la carte installation may take a little longer, but just about any CD-ROM drive and powered speakers will work with any sound board. Even if your sound board doesn't have a connector for the quadruple-speed CD-ROM drive you want, you can use a separate adapter card for the drive.

Many of the components tested for this feature are found in multimedia PCs and upgrade kits (see the tables "Multimedia Components in Systems" and "Multimedia Components in Upgrade Kits" on the following page. If, after reading these reviews and comparing the test results, you find that the drive, sound card, and speakers you prefer aren't offered in a fixed-price package, go à la carte. You won't be hungry again for a long time. □

THREE WAYS TO UPGRADE



	MULTIMEDIA PCs	UPGRADE KITS	COMPONENTS
What are they?	A PC system purchased with the CD-ROM drive, sound board, and speakers installed.	A CD-ROM drive, a sound board, and usually speakers purchased together as a kit.	A CD-ROM drive, a sound board, speakers, and software purchased separately from different vendors.
Who offers them?	Most PC vendors, including Apple, AST, Compaq, Dell, Digital, Epson, Gateway 2000, Hewlett-Packard, IBM, NEC, Packard Bell, and Zenith.	Most CD-ROM drive and sound card vendors, including Aztech Labs, Creative Labs, Diamond Computer, Media Vision, and Reveal.	*CD-ROM DRIVES:* Mitsumi, NEC, Panasonic, Plextor, Sony, and others. *SOUND BOARDS:* Aztech Labs, Creative Labs, Media Vision, Turtle Beach, and others. *SPEAKERS:* Altec Lansing, Bose, Koss, Labtec, Panasonic, Sony, Yamaha, and others.
Pros	In most cases, components come installed, so no component installation is necessary. Buying a multimedia PC usually costs less than buying a system and kit or the components separately.	Kit vendors have solved the problem of making the multimedia components work with one another. Documentation usually covers the kit as a whole. Buying a kit is usually less expensive than buying the components separately.	Users can choose the best multimedia components for their needs. No compromises are required if price is not an object.
Cons	System vendors usually offer a limited choice of components.	Choosing among packages rather than individual components may require compromises. Installation is required and may be difficult.	Installation is difficult. You will usually have to pay more than you would for a kit, and you usually won't get much free software, if any.
Ideal user	The average home or business user who has already decided to purchase a new system.	The home or business user upgrading an existing system to run multimedia applications.	A developer, a professional graphic artist, or any user with special needs. Or simply the user who will accept only the best.
Installation required	None; the system needs only to be set up. Documentation usually covers the system and components.	Installation is usually a matter of installing a sound board, then connecting the CD-ROM drive to the CD connector on the sound board and the speakers to the sound board line-out jack. Driver installation is also required. You may run into interrupt, DMA, or I/O address conflicts with other devices.	If the sound board or system does not come with an adapter for a CD-ROM drive, you will have to purchase a separate adapter. Each component has to be installed individually, and each has its own documentation. You will probably have to deal with interrupt, DMA, and I/O conflicts.
Cost	Usually only a few hundred dollars more than a standard system.	$300 to $1,000, depending on the quality of the components.	Almost any price, depending on the components.

MULTIMEDIA COMPONENTS IN SYSTEMS

This table shows which CD-ROM drives, sound boards, and powered speakers currently ship with selected desktop systems sold by the top ten PC vendors. Vendor rankings were provided by CI infoCorp and are based on the number of units sold in the U.S. in 1994.

Rank	Company	PC lines	CD-ROM drive bundled with selected configurations	Sound board bundled with selected configurations	Speakers bundled with selected configurations
1	Compaq Computer Corp.	All Compaq lines	Info not available	Info not available	Info not available
2	IBM Personal Computer Co.	Aptiva 310, 330, 350, 510 710 series	Mitsumi FXN01DE	Creative Labs Sound Blaster 16 Value Edition	Labtec CS-150
		Aptiva 530, 730 series	Mitsumi FXN01DE	Prometheus Products Ana 16 Wavetable	Jazz Hipster AV-580
		PC 300 and PC 700 series	Mitsumi FXN01DE	Creative Labs Sound Blaster 16 Value Edition	Suite Sounds' S3 Sound Cubes
3	Packard Bell Electronics Inc.	All Packard Bell lines	Panasonic CR-563-X	Aztech Labs-designed proprietary 16-bit card	Packard Bell SPK-229
4	Dell Corp.	Dimension, OmniPlex, and OptiPlex lines	NEC CDR 260 R or Sony CDU-55E	Creative Labs Sound Blaster 16	Altec Lansing ACS-31 or ACS-5
5	Gateway 2000 Inc.	Family P5-60, P5-75, 4DX2/66	NEC CDR 260-GDR	Creative Labs Sound Blaster 16	Altec Lansing ACS-5
		Family P5 90	Mitsumi FX400	Creative Labs Sound Blaster 16	Altec Lansing ACS-5
		Professional Systems P5-100XL	Mitsumi FX400	Ensoniq Soundscape	Altec Lansing ACS-31
6	AST Research Inc.	Advantage Adventure line	Mitsumi FX400 Sanyo CDR-S1G or Toshiba XM 5302B	Creative Labs Sound Blaster 16	AST proprietary speakers
		Premmia GX line	Sanyo CDR-400I	Creative Labs Sound Blaster 16	None
7	Hewlett-Packard Co.	HP Vectra Communications PCs	NEC CDR 210 P 16-bit audio, fax, telephony card	HP-designed Sound Blaster-compatible	None
		HP Vectra Multimedia PCs	NEC CDR 210 P 16-bit audio/CD card	HP-designed Sound Blaster-compatible	Proprietary front-panel speaker
8	NEC Technologies Inc.	Image line	Quadruple-speed ❶	Logitech SoundMan Wave	Altec Lansing ACS-5
		PowerMate VP-75	Quadruple-speed ❶	Creative Labs Sound Blaster 16	Altec Lansing ACS-5
		All other PowerMates	Quadruple-speed ❶	Creative Labs Sound Blaster 16	QuickShot Technology's Sound Mate 4
		Ready 5010, Ready 7010, and Ready 7020	Mitsumi FX400	Boca Research SoundExpression	QuickShot Technology's Sound Mate 4
		Ready 9010 and Ready 9510	Mitsumi FX400	Boca Research SoundExpression	Labtec CS800
		Ready 9520	Mitsumi FX400	Boca Research SoundExpression	Altec Lansing 5110
9	Digital Equipment Corp.	Celebris and Venturis lines	Philips CM207	KTL Sound Power Pro Jazz 16	Labtec CSP4
		Starion 200 and 300 series	Philips CM207	Prometheus Pro Modem Audio Drive PMD-80	Labtec CS-150
		Starion 400, 500, and 700 series	Philips CM207	Prometheus Pro Modem Audio Drive PMD-80	Labtec CS-600
10	AT&T Global Information Solutions	Globalyst 300 to Globalyst 499	Panasonic CR-572 or CR-574	MediaMagic Telemetry-32	AT&T/Bell Labs Talkbak
		Globalyst 500 to Globalyst 699 CR-574	Panasonic CR 504, CR-572, or Business Audio ❷	Proprietary version of Media Vision Talkbak	Optional AT&T/Bell Labs

❶ At press time, NEC Technologies had not yet settled on which quadruple-speed drive it will ship in its systems
❷ This month, AT&T plans to change to either the Creative Labs Sound Blaster 16 or the MediaMagic Telemetry-32, a decision had not been made by press time
Note: Vendors may change components at any time

MULTIMEDIA COMPONENTS IN UPGRADE KITS

This table shows which CD-ROM drives, sound boards, and powered speakers ship with multimedia upgrade kits sold by the market-leading vendors.

Company	Multimedia upgrade kit	CD-ROM drive	Sound board	Speakers	Price
Aztech Labs Inc.	Sound Galaxy Stellar	Aztech CDA268-03i	Sound Galaxy 16i	Proprietary Aztech	$239.00
	Sound Galaxy Voyager Deluxe	Aztech CDA268-03i	Sound Galaxy 16i	Aztech FX-20	$269.00
	Sound Galaxy WaveRider 32+	Aztech CDA268-03i	WaveRider 32+	Aztech FX-20	$449.00
	Sound Galaxy Voyager Quad	Aztech CDA468-01i	Sound Galaxy 16i	Aztech FX-20	$449.00
Creative Labs Inc.	Sound Blaster Discovery New Edition	Panasonic CR-563	Creative Labs Sound Blaster 16	Creative Labs SBS38	$379.95
	Sound Blaster Value CD	Panasonic CR-563	Creative Labs Sound Blaster 16	Creative Labs SBS38	$349.95
	Sound Blaster Digital Schoolhouse	Panasonic CR-563	Creative Labs Sound Blaster 16	Creative Labs SBS30	$399.95
	Sound Blaster Edutainment CD 16	Panasonic CR-563	Creative Labs Sound Blaster 16	Creative Labs SBS38	$599.95
	Game Blaster 16	Panasonic CR-563	Creative Labs Sound Blaster 16	Creative Labs SBS38	$549.95
	Sound Blaster 16 Multimedia Home 4x	NEC CDR-271	Creative Labs Sound Blaster 16	Creative Labs SBS38	$579.95
Media Vision Inc.	Premium Deluxe Multimedia Kit	Reno	Media Vision Premium 3-D	Proprietary Media Vision	$599.00
	Super Deluxe Multimedia Kit	Sanyo SMV94A	Media Vision Deluxe	Proprietary Media Vision	$499.00
	Family Deluxe Multimedia Kit	Sanyo SMV94A	Media Vision Deluxe	Proprietary Media Vision	$399.00
	Deluxe Multimedia Kit	Sanyo SMV94S	Media Vision MVI 16-bit	Proprietary Media Vision	$299.00
Reveal Computer Products	Quantum	Panasonic CR-563	Reveal SoundFX Wave	Reveal RS380	$549.00
	Voyager	Proprietary Reveal	Reveal SoundFX	Proprietary Reveal	$199.00
	Explorer	Panasonic CR563	Reveal SoundFX	Reveal RS250	$249.00

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- Two PCMCIA Type II slots (or one Type III)
- 3.5" 1.44MB Diskette Drive
- 9.5" Color Dual Scan Display (8.4" Color TFT available, shown above)
- Integrated Trackball
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THE NEWEST SPIN ON CD-ROM DRIVES

Double-speed drives are fine for today's business, games, and edutainment titles, but powerful new applications requiring quadruple-speed performance are just around the corner.

By Ted Needleman

CD-ROM is not only here, it's a major part of the computing experience. According to the market research firm InfoCorp, sales of CD-ROM drives will almost double, from 14 million in 1994 to 25 million this year. At a superstore such as Circuit City or CompUSA, you'll see almost as much shelf space accorded to CD-ROM titles as to floppy disk–based software. With many multimedia and reference titles available only on CD-ROM, it's clearly time to add a drive if your system lacks one.

REVIEW CRITERIA

To help you decide which drive is best for your needs, we tested 30 CD-ROM drives from 22 vendors. To be eligible for review, each drive had to

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be at least MPC Level 2–compatible, which means a double-speed drive with a maximum 400-ms access time and a CPU utilization of no more than 60 percent. *Double-speed* refers to a data-transfer rate of 300 kilobytes per second (KBps); the first CD-ROM drives on the market, now called single-speed, ran at 150 KBps. *CPU utilization* refers to the percentage of the CPU's bandwidth occupied by servicing the CD-ROM subsystem (the less the better). The drive also had to be shipping by mid-November 1994. For this review, we also attempted to include OEM drives sold to PC vendors, so you could compare drives that come with systems against CD-ROM drive products sold directly to end users. For example, we reviewed the NEC MultiSpin CDR-260R, found only in Dell systems; the Mitsumi FXN01DE, found in IBM systems; and the Mitsumi FX400, found in Gateway systems. None of these drives are currently available directly to end users. Mitsumi expects the FX400 to be available to end users by the time you read this. It will also be included in NEC systems.

Several drives either were not shipping or did not arrive in time for our testing. These include quadruple-speed products from Aztech Labs, Chinon America, Disk Technologies Corp., Fidelity International Technologies, Goldstar USA, Liberty Systems, NEC Technologies, Pacific Rim Systems, PerifiTech, Sony Electronics, TEAC America; double-speed drives from Disk Technologies, Goldstar, and NEC; the new 15-speed drive QuickCD 15X from Peripheral Land; the 18-disk changer DRM-1804X from Pioneer New Media Technologies; and the battery-operated CD-ROM Discman, a 10-ounce portable CD-ROM player from Sony.

PC Labs ran a comprehensive suite of performance tests on each of the drives to measure throughput, access time, and performance running multimedia applications. In general, we found that performance closely followed data-transfer rate—but not always. CD-ROM performance can also depend on factors such as buffer size and efficiency, and the quality of the driver. The Editors' Choice Sony CDU-55S, for example, runs slightly faster than double-speed, yet it beat out half of the quadruple-speed drives we tested when it came to multimedia playback performance. (See "How We Tested.")

DOWN WITH PROPIETARY, UP WITH SCSI AND IDE

SCSI has emerged as the current vendor favorite CD-ROM drive interface at the high end of the market—as evidenced by the 19 SCSI-based drives we received, out of a total of 30. Double-speed SCSI drives had list prices starting at $239.95—for the GoldStar GCD-R320B—while 6 of the 7 IDE-based double-speed drives had list prices from $125 to $199. And 12 of the

HIGHLIGHTS

CD-ROM Drives

It's no longer a matter of keeping up with the techno-Joneses. CD-ROM drives are becoming an integral and indispensable part of the PC experience. Fortunately, drives have also become affordable and easy to install.

SALES OF CD-ROM DRIVES may top 25 million units this year, almost double the number sold in 1994. As more and more software titles appear on CD-ROM exclusively, you're missing out if your PC can't read the silvery disks.

The main decision you must make when mulling over a drive purchase is what speed. Double-speed drives have usurped single-speed units as the de facto standard, and most prove adequate for playing back educational/reference titles and games. Prices of double-speeds have fallen dramatically, to as low as $149—ideal for users with budget constraints.

YOU'LL NEED TO INVEST more for a quadruple-speed drive, but the performance gain will be noticeable. A rated throughput of 600 kilobytes per second means that CD-based applications will load faster and database searches involving heavy sequential activity, such as loading large index files into RAM, will be faster, too. More important, audio and video playback of true multimedia titles will be generally better. More demanding multimedia files can choke double-speeds, causing dropped audio snippets and jittery video. Most quad-speeds can handle the current generation of multimedia titles with aplomb, and they're ready to tackle the even more difficult video playback coming down the pike. A third alternative is the in-between-speed drives: In this review, a "2.4-speed" unit from Sony and triple-speed models from NEC offer better performance than traditional double-speeds at a small price premium.

ANOTHER ITEM to pay attention to is the drive's interface. SCSI has become dominant in the market, especially with quad-speed vendors. On midrange and low-end drives, proprietary connectors are giving way to industry-standard IDE/ATAPI interfaces. But on our tests, we didn't see a clear performance advantage of one over the other. For use on the road, some of the drives let you connect to your PC's parallel port. Be warned, though, that a drive's performance in such a configuration will be closer to that of a single-speed unit. If your notebook offers a type II PCMCIA slot, you can get SCSI performance by connecting your drive to a PCMCIA SCSI adapter card.

FINALLY, there are many small decisons to make. A caddyless drive is fine for the average user, but heavy disk swappers should consider a caddy-based unit. If you don't need a transportable unit and can spare an extra drive bay, an internal drive will save you about $100. A drive with a large buffer (256K or more) will most likely yield the best multimedia performance. For playing back audio CDs, make sure your drive comes with either audio outputs or a Redbook audio cable.

SCSI drives either come with their own SCSI adapter cards or offer them as an option. The rest leave you to choose a SCSI card on your own; we tested these 7 drives with an industry-standard Adaptec AHA-1542CF SCSI adapter.

When we reviewed CD-ROM drives last year ("The World of CD-ROM," February 22, 1994), we found five entry-level drives that came with proprietary connectors and interface cards. Most of these connectors are specific for drives based on either Mitsumi, Panasonic, or Sony drive mechanisms. This year, we found only one: the Creative Labs OmniCD.

Now, 8 of the 11 non-SCSI drives come with interfaces that comply with the new ATAPI (AT Attachment Packet Interface) IDE standard introduced as part of the Enhanced IDE specification by Western Digital in 1994. The ATAPI IDE spec allows you to plug your IDE CD-ROM drive directly into an IDE connector on your system's motherboard. For the rare event that you would run out of motherboard connectors, or that the drive simply would not work with your motherboard IDE connector, each of the vendors of IDE CD-ROM drives either includes an IDE adapter card or offers one as an inexpensive option ($15 to $40).

Proponents of the E-IDE/ATAPI interface tout ATAPI IDE drives as being easy to install, a breeze to configure, and better performers than drives with proprietary connectors. Our tests of IDE-drives backed up these claims. In most cases installation was simply a matter of connecting the drive to an IDE connector on the motherboard and running a quick setup program to install the driver. The performance of IDE drives was not noticeably different from that of SCSI drives.

For users of portable and transportable external drives, there are fourth and fifth possibilities: a parallel connection or a PCMCIA SCSI connection. Eight of the drives we looked at—all external units—offered a parallel interface; six of those were SCS-to-parallel. Just plug the drive into the PC's parallel port, install the driver, and you're off. It couldn't be easier. It could, however, be faster. The slow throughput of the parallel bus acts as a bottleneck that dramatically reduces drive performance, usually to below the MPC Level 2 minimum. Luckily, six of the eight drives with parallel ports also offer a standard SCSI interface. If your notebook offers a type II PCMCIA slot, you can get SCSI performance by connecting your drive to a PCMCIA SCSI adapter card.

For quadruple-speed:

- **Toshiba XM-3501**

For double-speed:

- **Sony CDU-55S**
- **Philips CDD300**

The quad-speed field has tightened somewhat since last year, with more drives delivering standout performance. The double-speed pack also boasts several worthy contenders.

Of the quad-speed CD-ROM drives, we especially liked the performance and overall value of the Toshiba XM-3501. Several other drive makers use the Toshiba mechanism in their units, but the XM-3501 alone deserves Editors' Choice recognition. It delivers better multimedia performance at a very competitive $400, and was among the best performers on our multimedia test suite, dropping fewer frames than others to deliver jitter-free playback. On our Custom AVI file, where 30-frame-per-second video is meant to bring quad-speeds to their knees, the XM-3501 bested all other drives, proving that it is ready for even the most demanding multimedia applications.

PC MAGAZINE EDITORS' CHOICE

An honorable mention goes to the NEC MultiSpin 4Xi ($495 street). This internal quad-speed showed good throughput and fine video handling on our tests. Thanks to NEC's Simple Start installation program, setup was a snap. Another quad-speed unit, the Pioneer DRM-604X ($995), also earns an honorable mention. On last year's tests, it was far and away the best performer and won Editors' Choice. It's still an excellent performer, though other units have since surpassed it. But the real allure here is the unit's six-CD magazine, which lets you keep six of your most used CDs loaded and ready. If you swap disks often, consider the Pioneer.

We were awed with the performance of Sony's hybrid 2.4-speed CDU-55S. For $249.95 list—a small premium over standard double-speed drives—you get performance that meets or exceeds some quad-speed units we tested. If you need more performance than double-speeds can deliver but can't make the financial leap up to quad, consider this Editors' Choice.

We also award an Editors' Choice to the Philips CDD300, a standard IDE/ATAPI double-speed unit. The drive's performance was excellent among double-speeds on both our application and multimedia playback suites. A $199 street price makes it a bargain. The double-speed Panasonic LK-MC579BP ($249 list) deserves an honorable mention. Extra touches, such as EZ-Installer software and a special platter that lets you use the caddyless drive mounted vertically, make the Panasonic worth more than pure budget-priced units.

Our Contributors: JOHN R. QUAIN is a contributing editor to *PC Magazine*. STEVEN C. M. CHEN, BILL DYSZEL, JONATHAN HILL, JAMES KARNEY, and TED NEEDLEMAN are frequent contributors to *PC Magazine*. JACQUELINE EMIGH is a freelance writer. LEON ERLANGER was the associate editor in charge of this story, and MICHAEL J. ZULICH was the project leader.

FAST, FASTER, FASTEST?

When we looked at double-speed drives last year, they were just coming into their own. Many of them had list prices from $500 to $700. Quadruple-speed drives were interesting oddities, and single-speed drives were value-priced, albeit fading. This year, single-speed drives are dead and buried, and double-speed drives predominate. Eighteen of the 30 drives we tested were double-speed units, with street prices as low as $125. More interesting, however, is that 12 of the drives we received this year are capable of better than double-speed: the 2.4X-speed Sony CDU-55S ($249.95), the triple-speed NEC MultiSpin 3Xp Plus ($495), and the 10 quadruple-speed units ranging from $299 for the Mitsumi FX400 drive available in a Gateway 2000 PC to $995 for Pioneer's six-disk changer, the DRM-604X. We tested one other changer, the double-speed Mountain CD7 ($649), which holds seven disks.

If you do a lot of disk swapping, storing your CDs in disk caddies will mean fewer fingerprints and less chance of damage to the disks.

Quad-speed is clearly the wave of the future as CD-ROM applications demand more speed. CD-ROM–based software ranges from reference services for lawyers, accountants, and doctors to full-blown multimedia encyclopedias. You'll find content presented in many different ways, from text and graphics to animation, sound, and motion video. Many companies are even beginning to use compact disk–recordable drives to back up data onto CD-ROM. Not all of these uses of CD-ROM benefit from better CD-ROM drive performance.

Many applications, however—especially those that use motion video—do benefit from speedier equipment. And while some strides in compression technology are improving the display size and frame rate of stored video, some of the performance boost also comes from a drive's ability to transfer data as quickly as possible. Today's multimedia programs have been designed to run on double-speed drives, but their motion-video clips are usually limited to 12 or 15 frames per second with 256-color and screen-size frames. Games that can take advantage of triple-speed drives, like Rebel Assault and Wing Commander 3, have already appeared on the market, and quad-speed–ready edutainment applications are expected to follow soon. Serious training applications that use video will undoubtedly require larger video windows, more color, and frame rates that are closer to the 30-frame-per-second rate of television. Hence, we put 30-fps video in the Custom AVI file we devised for our multimedia test suite (thanks to assistance from Jan Ozer of Docee Publishing in Norcross, GA). InfoTech, a market research firm based in Woodstock, Vermont, predicts that by the end of 1995 most PC systems will be shipping with quadruple-speed drives, and prices of quad-speed units will be close to those of double-speed products today. Most PC vendors already offer quad-speed drives as an upgrade option.

DECISIONS, DECISIONS

Eight of the quad speed drives require disks to be placed in $5 caddies, which are then inserted into the drive. The vendors that use them say caddies offer greater protection against dust and scratches to your CD-ROMs. If your drive will be on a network, or if you know you'll be doing a lot of disk swapping, storing your CDs in disk caddies will undoubtedly mean fewer fingerprints and less chance of damage to the disks—both inside and outside the drive. If you are the average home or small-business user, however, a caddyless drive will probably be fine. Keep in mind, however, that caddyless drives cannot function when the PC chassis is turned on its side. One exception is Panasonic's internal LK-MC579BP, which features a special platter that lets you use the drive vertically.

Make sure your drive is compatible with Kodak's multisession PhotoCD standard. PhotoCD is a format for storing digitized photographs on CD. Multisession means you can have digitized photos added to your CDs in multiple sessions. CD-ROM XA, a standard for interleaving sound within a file on the disk, is still not a major consideration for most users (or vendors)—but it may be in the future.

If you don't need to transport your CD-ROM drive or use it with two or more different systems, and if your system has an extra drive bay, get an internal drive. Internal drives generally sell for $100 less than external units. If you need the portability, make sure your external unit is not limited to a slow parallel connection.

Another feature to consider is buffer size. The buffer on a CD-ROM drive is dedicated memory that temporarily stores data sent from the drive and shoots it across the bus in bursts, rather than tying up the CPU with the slow, constant stream of data produced by the drive. Generally speaking, a larger buffer (256K or more) means better performance. But the way the buffer balances the data it receives with the data it sends across the bus can also affect performance.

Consider what types of connections your system already offers. If you have some free IDE connectors available on your motherboard, consider an ATAPI IDE–compliant drive. If you already have a SCSI adapter installed for your hard disk or scanner, or if you have a sound card that offers a SCSI CD-ROM interface, consider a SCSI drive. Portable users may want a drive that offers both SCSI and parallel connections.

Carefully weigh the advantages and disadvantages of saving money today by purchasing a double-speed drive versus spending a few hundred dollars more for a quad-speed to be ready for tomorrow's applications. PC standards progress quickly, and you may find that the high-performance drive you purchase today is barely adequate tomorrow.

Advanced Logic Research Inc.

• ALR Express CDE-1200

Aztech Labs Inc.

• Aztech CDA268-03i

BY STEVEN C. M. CHEN

The ALR Express CDE-1200 and Aztech CDA268-03i, based on the same Philips drive mechanism, both have 128K buffers and 350-millisecond access times. With average performance, a standard ATAPI

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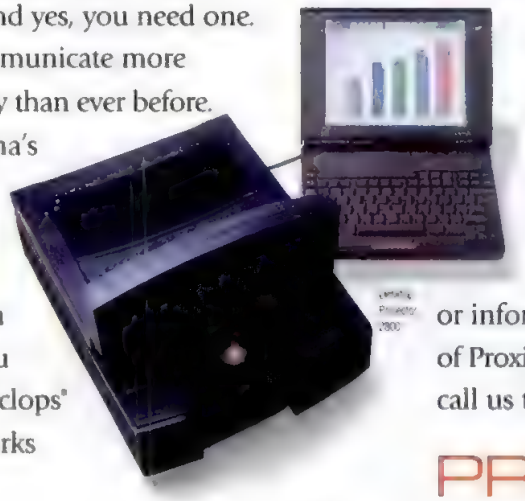

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Performance Tests: CD-ROM Drives

CONTINUES

What the Numbers Mean

Predictably, quadruple-speed drives generally outperformed their double- and triple-speed siblings on our tests. It was not an unbroken rule, however, as some tests saw a few double-speed units beat some of the quad-speed entries.

In general, CD-ROM drive throughput is a good measure of how well a drive will perform. So, as expected, the quadruple-speed drives as a group outperformed the double- and triple-speed drives—but not without exception. The real-world performance of a drive is affected by a host of variables—the adapter card, the driver, the size and efficiency of the buffer—so while quad-speed throughput figures were unfailingly better than those managed by the slower-rated drives, some of the slower drives prevailed on our application and multimedia tests.

On our Application Launch test, for example, the 2.4-speed Sony CDU-55S and six double-speed units beat or tied the 17-second showing of the slowest quadruple-speed SCSI units. On the Application Search test, 12 of the 20 slower-spinning drives were able to top or tie the average time of 10 seconds posted by units in the quad-speed group. And even on the Multimedia Playback tests, where demanding audio and full-motion video playback should give the quad-speed entries a decided performance advantage, some of the slower—and much less expensive—drives turned in better performances.

The quad-speed drives did do better on our test involving a custom AVI file, where the 30-frame-per-second video proved too demanding for anything less than a quad-speed. As multimedia applications grow more sophisticated, you may find that a double-speed drive just won't deliver.

We also found that a drive's interface has no bearing on performance, except for inherently slower parallel-port units. But SCSI, Enhanced IDE, and proprietary IDE drives tested equally within their class.

How We Tested

We ran all of the CD-ROM tests on an IBM ValuePoint 466DX2/Dp with 16MB of RAM, a 256K L2 cache, a 365MB hard disk, and an S3 864 graphics controller set to 800-by-600 resolution and 24-bit color. IBM PC-DOS 6.3 and Microsoft Windows 3.1 made up the software environment. For audio playback we used Media Vision Pro Audio sound cards and Altec Lansing ACS300.1 speakers. All of the tests, except the CD-ROM Throughput test and the Seek and Read test, were run with a 2MB software cache and IBM SmartDrive, Version 5.0.

We tested each drive using the vendor's recommended interface board. We connected each Enhanced IDE unit to the secondary IDE connector on the motherboard; for the Panasonic LK-MC579BP, we had to daisy-chain the drive off the connector attached to the hard disk. (This did not seem to degrade performance, though.) Those SCSI products that did not ship with interface boards were tested with an Adaptec 1542CF SCSI host adapter.

IDE interface, and a bargain street price of $149, either product is a good solution for the entry-level user of text databases, multimedia games, and edutainment applications. Until recently, ALR's products were sold mostly through value-added resellers but, like Aztech Labs, ALR is now selling peripherals, including the ALR, to consumers through mail-order and retail channels.

The Philips CDD300, which we review elsewhere in this feature, is based on the same mechanism but has a 256K buffer and an average access time of 290 ms. The difference in specs is reflected in relative performance: The ALR and the Aztech came out just about average on all tests among double-speed SCSI and IDE drives reviewed here, while the Philips drive was an above-average performer. The Aztech, however, did come out above average and ahead of the ALR on the Intel Indeo multimedia playback test, with no dropped video frames, compared with 16 for the ALR. In our subjective testing, multimedia applications played back smoothly without visible breaks in all three drives.

Installing both products is straightforward thanks to their standard ATAPI IDE interfaces, which let you connect each drive to a secondary IDE connector on your motherboard. In case you run out of IDE connectors, or the IDE connector on your system is not compatible with the drive, ALR offers an IDE paddle card for only $12; Aztech Labs includes one for no extra charge. After you finish the physical installation, you run an included setup disk that installs appropriate drivers automatically.

ALR Express CDE-1200, Aztech CDA268-03i

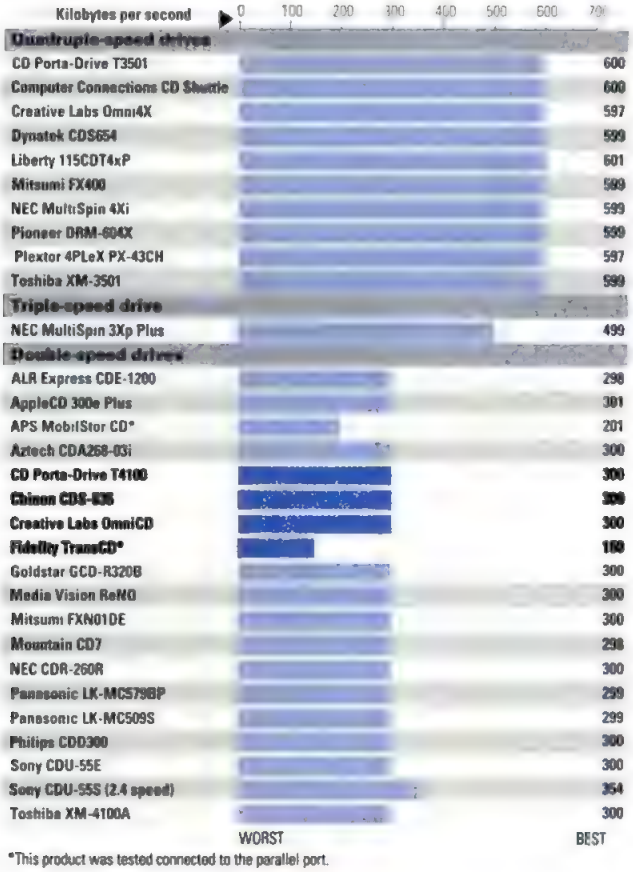
In the case of the ALR product we have two objections to the otherwise simple installation: The pin 1 position for the drive's IDE connector is not labeled (the Aztech's is), so we had to refer to the manual to get the connections right. And the CDE-1200 requires a hefty 63K of conventional memory for its CD device driver and MSCDEX, compared with 49K for the Aztech product.

Both drives are caddyless, and each comes bundled with a three-pin analog audio cable that should work well with most popular sound cards. Next Track, Last Track, and Play buttons let you play audio CDs without having to run software. Red Book audio was crisp and clean. No CD applications are packaged with the ALR drive; Aztech offers its drive with one game disk or business-related CD for $179 list.

▶ **ALR Express CDE-1200.** Estimated street price: *$149; optional IDE interface,*

CD-ROM THROUGHPUT

TEST DESCRIPTION The CD-ROM Throughput test measures a drive's raw sequential data throughput rate. Each drive reads our test CD sequentially from beginning to end in 64K blocks. We report the throughput in kilobytes per second. (We chose 64K block sizes to achieve maximum throughput.)

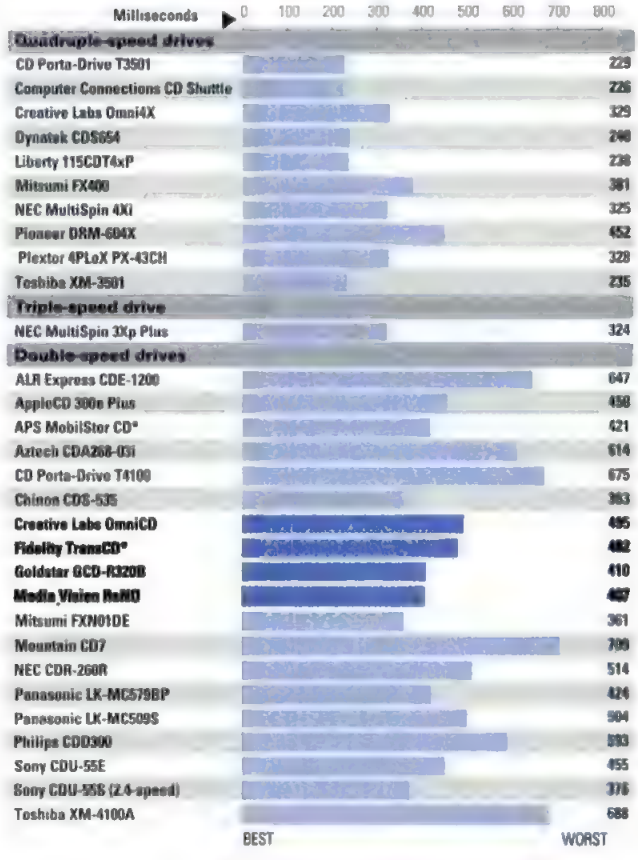


*This product was tested connected to the parallel port.

DISCUSSION Each drive has a rated throughput specification based on its spin rate: 300 kilobytes per second for double-speed drives, 450 KBps for triple-speed drives, and 600 KBps for quad-speed drives. Throughput that falls 10 percent or more below the rating indicates that the combination of the controller and device driver causes a performance bottleneck. Drives generally performed within specification; the exceptions were the double-speed Fidelity TransCD and the double-speed APS MobilStor CD, which we tested through the parallel port.

SEEK AND READ

TEST DESCRIPTION The Seek and Read test measures the speed at which a CD-ROM drive positions its read head to the data you are searching for. The test reads 2K sectors, starting with a stroke halfway across the CD and proceeding with successively reduced stroke distances. The time required to complete the test is measured in milliseconds.



DISCUSSION Quad-speed drives based on a Toshiba mechanism—the Computer Connections CD Shuttle PSM, CD Porta-Drive T3501, Toshiba XM-3501, Liberty 115CDT4xP, and Dynatek CDS654—were the fastest of the group, ranging from 226 ms to 240 ms. The worst quad-speed score (452 ms) was posted by the Pioneer DRM-604X, a six-disk changer that started the operation with the disk at rest rather than spinning, as single players do. Among the double-speeds, the Mitsumi FXN01DE (361 ms) and the Chinon CDS-535 (363 ms) had impressive scores.

$12. Advanced Logic Research Inc., *9401 Jeronimo Rd., Irvine, CA 92718; 800-444-4257, 714-581-6770; fax, 714-581-9240.*

Circle 447 on reader service card

▶ **Aztech CDA268-03i.** List price: *$159 (includes IDE interface).* Aztech Labs Inc., *47811 Warm Springs Blvd., Fremont, CA 94539; 800-886-8829, 510-623-8988; fax, 510-623-8989.*

Circle 448 on reader service card

Apple Computer Inc.

• AppleCD 300e Plus

BY BILL DYSZEL

The AppleCD 300e Plus, with a list price of $369 for the external version and $315 for the internal version, is one of the more expensive double-speed drives we reviewed, but you get good performance and a nice package for the price. The AppleCD 300e Plus is a SCSI device primarily meant for the Macintosh market. Apple includes documentation for Macintosh installations only and does not offer a SCSI adapter for PCs. Nevertheless, we found installation to be almost effortless; it took only about 10 minutes using our Adaptec AHA-1542CF SCSI adapter and EZ-SCSI software. We test-

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MULTIMEDIA PLAYBACK

TEST DESCRIPTION So that we could gauge the quality of multimedia playback, Microsoft Corp. granted us permission to use VidTest, a Windows-based program that tests digital video performance. VidTest measures the number of video frames and audio segments dropped during playback of AVI files. Its Data Streaming test measures the percentage of CPU resources being consumed by the CD-ROM subsystem (CPU utilization). VidTest is not currently endorsed by the Multimedia PC Marketing Council (MPC), though it has become a de facto industry standard for measuring performance on multimedia PCs.

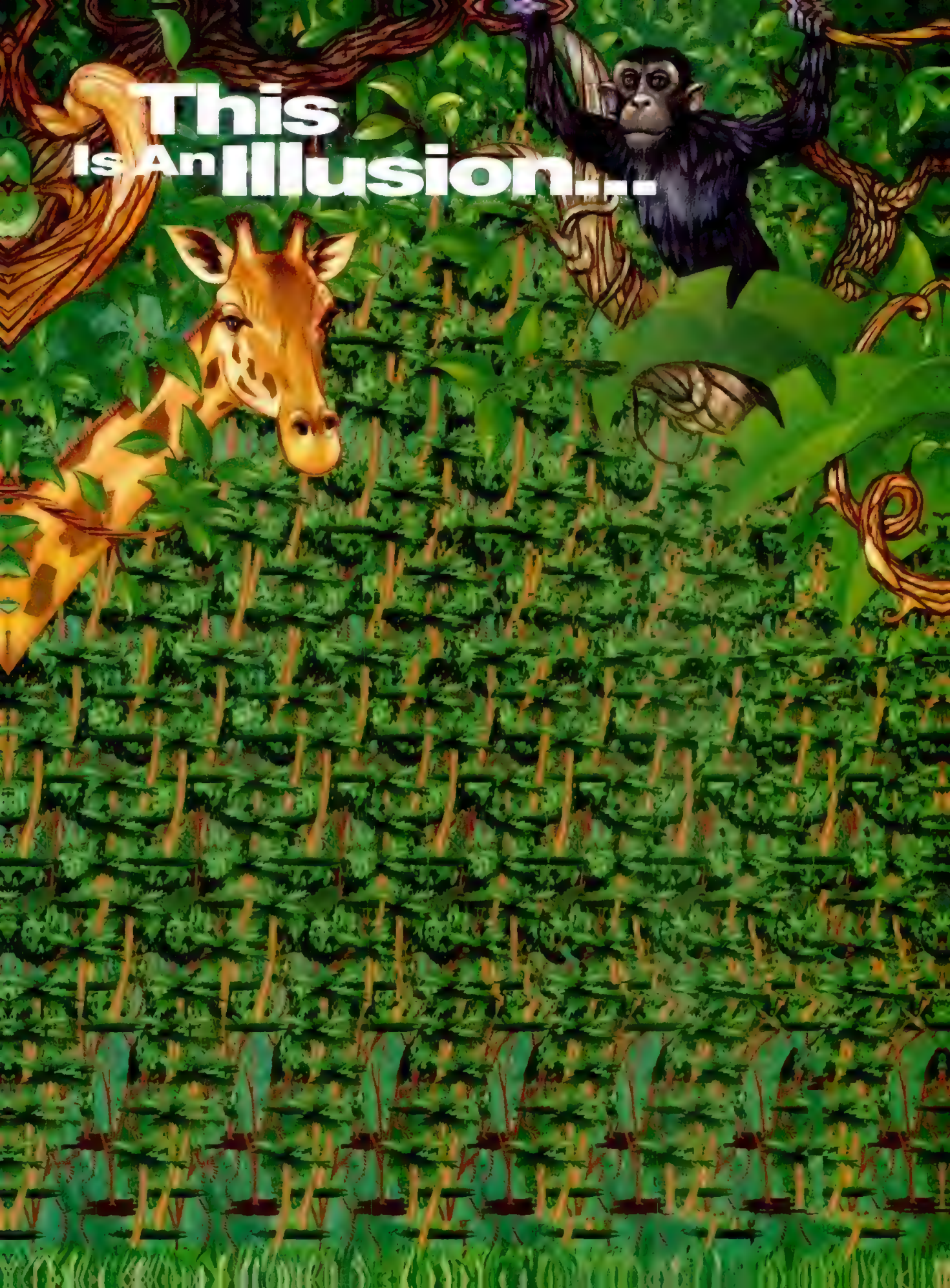
We used VidTest to play four different AVI files: Video 1 Compression at 16-bit color; Intel Indeo Video Compression at 24-bit color, Cinepak Video Compression at 24-bit color, and a *PC Magazine* custom AVI file at 24-bit color. The first three files contained 15-frame-per-second, 320-by-240 video; the custom AVI file contained 30-fps, 320-by-240 video and was designed to push the limits of the quadruple-speed drives.

Lower scores represent better performance.	Video 1 Compression (16-bit color, 912 frames, 15fps, 320-by-240 resolution)			Intel Indeo Video Compression (24-bit color, 912 frames, 15 fps, 320-by-240 resolution)			Cinepak Video Compression (24-bit color, 912 frames, 15 fps, 320-by-240 resolution)			Custom AVI file (24-bit color, 599 frames, 30 fps, 320-by-240 resolution)		
	Number of video frames dropped	Number of audio breaks	CPU utilization (percent)	Number of video frames dropped	Number of audio breaks	CPU utilization (percent)	Number of video frames dropped	Number of audio breaks	CPU utilization (percent)	Number of video frames dropped	Number of audio breaks	CPU utilization (percent)
Quadruple-speed drives												
CD Porta-Drive T3501	188	0	19	56	0	19	0	0	19	509	0	73
Computer Connections CD Shuttle	**179**	**0**	**20**	**67**	**0**	**21**	**0**	**0**	**21**	**510**	**0**	**75**
Creative Labs Omni4X	159	0	17	32	0	17	0	0	17	471	0	58
Dynatek CD8854	**184**	**0**	**20**	**26**	**0**	**20**	**0**	**0**	**20**	**502**	**0**	**71**
Liberty 115CDT4xP	75	0	14	2	0	12	0	0	14	310	0	49
Mitsumi FX400	**149**	**0**	**15**	**3**	**0**	**15**	**0**	**0**	**56**	**457**	**0**	**56**
NEC MultiSpin 4Xi	75	0	10	3	0	10	0	0	10	262	0	35
Pioneer DRM-604X	**86**	**0**	**14**	**3**	**0**	**14**	**0**	**0**	**14**	**381**	**0**	**50**
Plextor 4PLeX PX-43CH	73	0	10	3	0	10	1	0	10	519	11	100
Toshiba XM-3501	**77**	**0**	**10**	**3**	**0**	**10**	**0**	**0**	**10**	**242**	**0**	**34**
Triple-speed drive												
NEC MultiSpin 3Xp Plus	144	0	16	30	0	16	0	0	16	484	4	88
Double-speed drives												
ALR Express CDE-1200	158	0	15	16	0	15	1	0	15	512	9	100
Apple CD300e Plus	**119**	**0**	**16**	**3**	**0**	**16**	**0**	**0**	**16**	**501**	**8**	**100**
APS MobiStor CD*	724	1	74	597	0	73	458	0	74	N/A	N/A	N/A
Aztech CDA268-03I	**153**	**0**	**17**	**0**	**0**	**16**	**0**	**0**	**16**	**N/A**	**N/A**	**N/A**
CD Porta-Drive T4100	289	0	32	157	0	32	0	0	32	533	10	100
Chinon CDS-535	**139**	**0**	**16**	**31**	**0**	**16**	**1**	**0**	**16**	**513**	**0**	**100**
Creative Labs OmniCD	256	0	26	90	0	26	0	0	26	N/A	N/A	N/A
Fidelity TransCD*	**788**	**24**	**87**	**735**	**28**	**88**	**746**	**18**	**87**	**563**	**13**	**85**
Goldstar GCD-R320B	94	0	13	3	0	13	0	0	13	508	10	100
Media Vision ReNO	**216**	**0**	**34**	**82**	**0**	**25**	**0**	**0**	**25**	**526**	**10**	**100**
Mitsumi FXN01DE	188	0	22	29	0	21	0	0	22	521	10	100
Mountain CD7	**190**	**0**	**21**	**49**	**0**	**21**	**0**	**0**	**21**	**533**	**10**	**100**
NEC CDR-260R	266	0	28	119	0	28	0	0	26	539	1	100
Panasonic LK-MC579BP	**166**	**0**	**18**	**36**	**0**	**18**	**1**	**0**	**18**	**517**	**8**	**100**
Panasonic LK-MC509S	146	0	16	34	0	16	1	0	16	518	8	100
Philips CDD300	**102**	**0**	**15**	**3**	**0**	**14**	**2**	**0**	**14**	**803**	**8**	**100**
Sony CDU-55E	122	0	18	19	0	18	0	0	19	491	8	100
Sony CDU-55S (2.4-speed)	**95**	**0**	**13**	**3**	**0**	**13**	**0**	**0**	**12**	**476**	**7**	**100**
Toshiba XM-4100A	146	0	18	64	0	21	0	0	21	523	10	100

*This product was tested connected to the parallel port N/A—Not applicable The product could not read the custom-mastered test disk

DISCUSSION In contrast to SCSI and IDE drives, parallel-port drives consistently dropped more video frames, had more audio breaks, and required a larger percentage of CPU resources to view the AVI clips. The quad-speed drives tended to be the best AVI performers, allowing fewer video and audio breaks and requiring fewer CPU resources. This was not an unbroken rule, however. With the Video 1 Compression file, for instance, two double-speed drives (the Goldstar GCD-R320B and the Philips CDD300) and the 2.4-speed Sony CDU-55S dropped fewer video frames than half of the quad-speeds.

Our very demanding custom AVI file yielded three-tiered results. The best-performing drives dropped fewer than 400 video frames and used less than 50 percent of CPU resources. Top-tier drives were the Toshiba XM-3501, the NEC MultiSpin 4X, the Liberty 115CDT4xP, and the Pioneer DRM-604X. The remaining quad-speed drives, the triple-speed NEC MultiSpin 3Xp Plus, the 2.4-speed Sony CDU-55S, and the double-speed Sony CDU-55E filled out the second tier; they dropped between 400 and 520 frames and used more than 50 percent of their CPU resources. For the quad-speeds, these results are possibly due to inadequate buffer management and driver tuning. The Plextor 4PLeX PX-43CH's poor scores reflect some difficulty the drive had in reading our CD-R disk. Subsequent testing with a CD-ROM disk yielded better results, but they are not directly comparable with other results shown here.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–*PC Magazine*, September 27, 1994

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PC MAGAZINE EDITORS' CHOICE
Pentium-66 April 12, 1994
DX4-100 June 28, 1994

COMPUTER SHOPPER
Pentium-60 April 1994
Pentium-90 August 1994

PC WORLD
486DX2-66 January 1994, February 1994, March 1994, June 1994, December 1994, January 1995, February 1995, March 1995
DX4-100 October 1994, November 1994, December 1994, February 1995
Pentium-60 December 1994, January 1995
Pentium-66 June 1994, July 1994, August 1994, September 1994
Pentium-90 August 1994, September 1994, October 1994, November 1994, January 1995, February 1995

PC Best
Pentium-66 May 1994
Pentium-90 February 1995

Windows EXPERTS' PICK
Pentium-66 June 1994
Pentium-90 August 1994

Windows Magazine
Pentium-90 November 1994

W 100
486DX2-66 March 1994

Package 1		Package 2		Package 3		Package 4	
486DX2-50	$1345	486DX2-50	$1645	486DX2-50	$2145	486DX2-50	$2545
486DX2-66	$1395	486DX2-66	$1695	486DX2-66	$2195	486DX2-66	$2595
DX4-100	$1545	DX4-100	$1845	DX4-100	$2345	DX4-100	$2745
Pentium-60	$1645	Pentium-60	$1945	Pentium-60	$2445	Pentium-60	$2845
Pentium-75	$1695	Pentium-75	$1995	Pentium-75	$2495	Pentium-75	$2895
Pentium-90	$1995	Pentium-90	$2295	Pentium-90	$2795	Pentium-90	$3195
Pentium-100	$2195	Pentium-100	$2495	Pentium-100	$2995	Pentium-100	$3395
➤ 4MB RAM ➤ 340MB local bus IDE hard drive with 120K cache ➤ 3.5" 1.44MB floppy disk drive ➤ **Diamond Stealth 64-bit** PCI local bus SVGA color graphics card with 1MB DRAM ➤ ZEOS 14" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch ➤ Six-bay desktop case with two cooling fans ➤ Microsoft Mouse ➤ MS-DOS 6.2, Windows for Workgroups 3.11		➤ 8MB RAM ➤ 528MB local bus IDE hard drive with 120K cache ➤ **4X CD-ROM** drive and 3.5" 1.44MB floppy drive ➤ **Diamond Stealth 64-bit** PCI local bus SVGA color graphics card with 1MB DRAM ➤ ZEOS 14" 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch ➤ Six-bay desktop case with two cooling fans ➤ Microsoft Mouse ➤ MS-DOS 6.2, Windows for Workgroups 3.11		➤ 16MB RAM ➤ **850MB** local bus IDE hard drive with 256K cache ➤ **4X CD-ROM** drive and 3.5" 1.44MB floppy drive ➤ **Diamond Stealth 64-bit** PCI local bus SVGA color graphics card with 1MB DRAM ➤ **ZEOS 15"** 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch ➤ Six-bay desktop case with two cooling fans ➤ Microsoft Mouse ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ **Lotus SmartSuite**		➤ 24MB RAM ➤ 1GB local bus IDE hard drive with 256K cache ➤ **4X CD-ROM** drive and 3.5" 1.44MB floppy drive ➤ **Diamond Stealth 64-bit** PCI local bus SVGA color graphics card with 1MB DRAM ➤ **ZEOS 15"** 1024 x 768 non-interlaced SVGA color monitor, .28mm dot pitch ➤ Six-bay desktop case with two cooling fans ➤ Microsoft Mouse ➤ MS-DOS 6.2, Windows for Workgroups 3.11 ➤ **Lotus SmartSuite**	

4X CD-ROM Standard! (Packages 2, 3, 4)

Included With Every ZEOS Pantera:

- ➤ Genuine Intel® Processor. ZIF socket for easy upgrading.
- ➤ Diamond Stealth PCI local bus color graphics card with 1MB DRAM, upgradable to 2MB DRAM.
- ➤ Flash BIOS.
- ➤ Two high-speed serial ports and one enhanced parallel port on the motherboard.
- ➤ Slots: Three PCI & 4 ISA (486), 3 PCI & 5 ISA (Pentium).
- ➤ ZEOS 101-key space-saving keyboard.
- ➤ 200 watt power supply with built-in surge suppressor. Switchable between 115/230V.
- ➤ FCC Certified Class B; UL Listed.
- ➤ Complete ZEOS Customer Satisfaction Package.

486 & DX4 Extras:

- ➤ RAM expandable to 128MB.
- ➤ EPA Energy Star compliant.

Pentium™ 60 Extras:

- ➤ RAM expandable to 192MB.
- ➤ On-board Fast SCSI-2 option.

Pentium™ 75, 90 & 100 Extras:

- ➤ RAM expandable to 192MB.
- ➤ On-board PCI local bus Fast SCSI-2 and Ethernet LAN options.
- ➤ EPA Energy Star compliant.

Favorite Options

528MB to 1GB Hard Drive Upgrade.....$190

1MB to 2MB Video RAM Upgrade $59

Diamond Stealth 64/PCI Video Card with 2MB VRAM
Fastest 64-bit accelerated video.....$249

Upgrade from a 14" to a 15" Monitor
ZEOS SVGA NI, 1024 x 768, flat screen $95

Upgrade from a 15" to a 17" Monitor
ZEOS SVGA NI, 1280 x 1024, flat screen $345

SCSI Controller Chip
For on-board SCSI. Includes drivers.....$49

Internal 14,000 bps V.32 bis Modem with 14,400 bps Send/Receive Fax Modem.....$79

Internal 28,800 bps V.34 bis Modem with 14,400 bps Send/Receive Fax Modem.....$199

Front Drive Bay PCMCIA SwapBox
Installs into 3.5" drive bay. 2 Type II, or 1 Type III and 1 Type II $179

ZNYX EtherAction™ 32
32-bit PCI Ethernet LAN adapter. Includes 10Base5, 10Base2 and 10BaseT connections.....$199

Internal Tape Backup
80 to 250MB (with compression), includes backup software $149

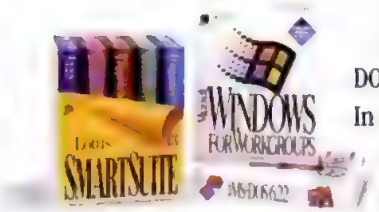
Multimedia Upgrade
Sound card and stereo speakers.....$128

10-Bay Vertical Case $95

Lotus SmartSuite Upgrade
Upgrade your existing Lotus application with Lotus SmartSuite (five applications) $299

Many other affordable upgrades and options available. Call for details!

Free Lotus SmartSuite!



All Pantera packages include Microsoft DOS 6.2 and Windows for Workgroups 3.11. In addition, packages 3 and 4 include Lotus SmartSuite—1-2-3, Ami Pro, Freelance Graphics, Organizer and Approach.

800-554-7172
24 Hours a Day
365 Days a Year

ZEOS INTERNATIONAL LTD

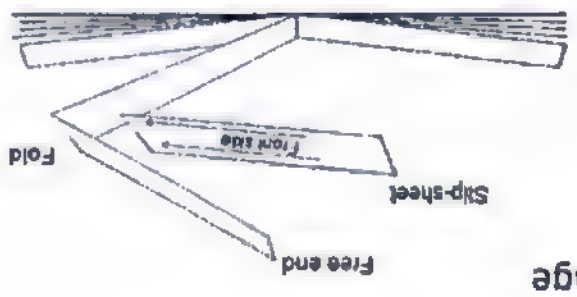
Fax Orders: 800-362-1205 or 612-362-1205. Phone Orders: Outside U.S. and Canada: 612-362-1212. Government: 800-245-2449. ZEOS Information Systems, Inc. GSA#GS00K94AGS5176.

Folded edge of the page

GbsSlipSheet-001

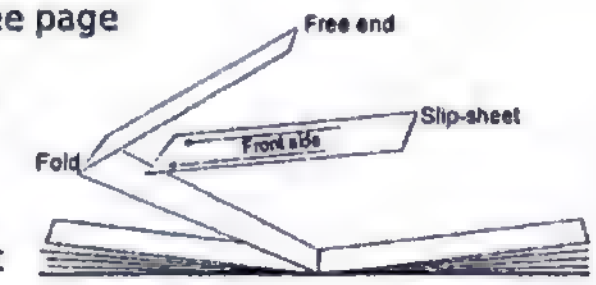
Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Foldout slip-sheet

1. Open the foldout page
2. Insert this sheet with
    1. Front side touching the free page
    2. Arrow pointing to the fold
3. Slice the folded edge
4. Close the page and slip-sheet



Inverted Back

1. Follow instructions on the other side

GbsSlipBack-0018

Back

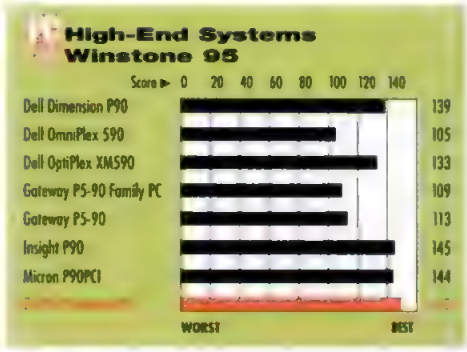
1. Follow instructions on the other side

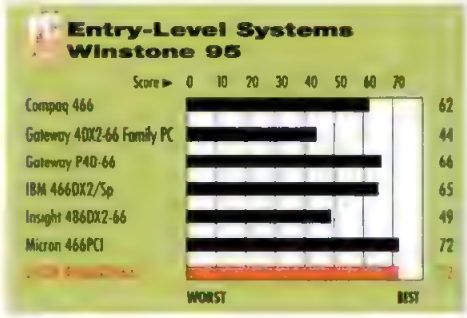
ZEOS® Pantera™— A Vision That's Real.

There's no illusion here. Truth revealed: ZEOS Pantera is your No. 1 high-performance desktop system. Leading experts from top industry publications agree. Unparalleled in its field, the Pantera has continuously earned award after award—review after review.

Month after month, the ZEOS Pantera outranks all others in performance, reliability, and value. It's the biggest bang for your buck. As *PC Magazine* said: "Overall performance leaders...the Pantera line has a lot to offer—strong performance at a reasonable price, with excellent documentation."

Continuing with the ZEOS tradition of providing you with top performance, unwavering reliability and exceptional value, the ZEOS Pantera is giving you a new way of looking at the world.





Reprinted from *PC Magazine*, December 6, 1994

Striking Performance

The Pantera, based on Intel's 486, DX4 and Pentium processors, is breaking record after record with its blazing performance and awesome power.

In *PC Magazine*'s December 1994 Pentium and 486 roundup, they gave top honors to the ZEOS Pantera: "Few product lines fared as well in our price/performance index as the ZEOS Pantera family. A major factor in the Pantera units' success was the outstanding Winstone 95 scores: The Pentium machines produced first-place scores in their respective tiers, and the ZEOS 486DX2-66 earned a top-five ranking among the entry-level systems."

PC World concurred: The Pentium-66 and Pentium-90 processor-based Pantera PCs were "the fastest system(s) ever tested... Mark a new high on the performance chart!"

What makes the Pantera the top performer—time after time? Superior engineering—starting with a ZEOS designed motherboard created specifically to take full advantage of the latest technological advancements. The motherboard is loaded with exceptional features such as an on-board PCI Local Bus IDE Controller and support for up to four IDE devices. For the fastest video performance, the Pantera includes a 64-bit Diamond Stealth PCI video card *standard*. For the quickest data throughput, most Pantera packages also include a 4X CD-ROM drive.

As *Windows Sources* said: "The clear winner is the ZEOS Pantera. Its scores were the best across the board."

Real Value

The ZEOS Pantera is a first-rate example of ZEOS' commitment to provide you with an excellent value on an award-winning machine. With all the extras, options, and 100% compatibility with all major operating systems—including Novell NetWare and OS/2—you can't go wrong.

And with our *Computers Now!* program, many of our most popular money-saving Pantera packages are ready to ship *the same day you order.* We also give you the option to custom-design a system to your exact computing needs.

Either way, you can buy with confidence because of our on-going dedication to provide you with high-quality features and state-of-the-art technology at an affordable price. As *PC/Computing* said, the Pantera "...is a deal you simply can't pass up."

And the value doesn't stop with your purchase. *PC World* said: "ZEOS's nonstop toll-free technical support schedule is unbeatable." *PC Magazine* agrees: ZEOS has won seven *PC Magazine* Readers' Choice for Service & Reliability awards. And we were the first to provide you with 24-hour toll-free technical support—every day.

Only one company gives you more features standard, incredible expandability, and supreme performance—all at an awesome price—ZEOS. And only one system gives you striking performance, unequaled reliability and the biggest bang for your buck—the ZEOS Pantera. To get the *Fastest Cat* around, call your ZEOS Systems Consultant today at 800-554-7172.

ZEOS® Can Ship Today!

Our most popular packages can be shipped the day you call.* Guaranteed!

486DX2-66 $1695
Pentium-60 $1945
Pentium-75 $1995

Package #2:

- 8MB RAM
- 528MB local bus IDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB FDD
- Diamond Stealth 64-bit PCI local bus SVGA graphics card with 1MB DRAM
- 14" SVGA color monitor
- 6-bay desktop case
- MS-DOS, Windows for Workgroups, Microsoft Mouse

486DX2-66 $2095
Pentium-75 $2395

Top Gun:

The above system modified to include:

- 128K SRAM cache (486), 256K SRAM cache (Pentium)
- Diamond Stealth 64-bit PCI local bus graphics card with 2MB VRAM
- 15" SVGA color monitor upgrade
- 14.4/14.4 send/receive fax modem
- Lotus SmartSuite

486DX2-66 $1245

Package #1:

- 4MB RAM, 128K SRAM cache
- 340MB hard drive
- 3.5" 1.44MB floppy drive
- VESA local bus SVGA color video
- 14" SVGA color monitor
- 4-bay desktop case
- MS-DOS, Windows for Workgroups, Microsoft Mouse

Pentium-75 $2595
Pentium-90 $2895

Editors' Choice:

- 16MB RAM, 256K SRAM cache
- 528MB local bus IDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB FDD
- Diamond Stealth 64-bit PCI local bus graphics card with 2MB VRAM upgrade
- 15" SVGA color monitor
- 6-bay desktop case
- MS-DOS, Windows for Workgroups, Microsoft Mouse
- Lotus SmartSuite

Pentium-75 $2745
Pentium-90 $3095
Pentium-100 $3295

Hottest:

The above system modified to include:

- 1GB local bus IDE hard drive
- 6-bay desktop case (Pentium-75) 10-bay vertical case (Pentium 90 & 100)

DX4-100 $2995

Package #3:

- 8MB RAM
- 350MB IDE hard drive
- External 3.5" 1.44MB floppy drive
- STN color VGA 7.9" display
- Custom carrying case
- Extra battery
- MS-DOS, Windows for Workgroups
- Lotus Organizer
- 7.8" x 10.2" x 1.7"; 3.9 lbs.

Pentium-75 $3118
Pentium-90 $3418

Best MM:

- 16MB RAM, 256K SRAM cache
- 528MB local bus IDE hard drive
- 4X CD-ROM drive, 3.5" 1.44MB FDD
- 16-bit sound card, stereo speakers
- Diamond Stealth 64-bit PCI local bus graphics card with 2MB VRAM upgrade
- 17" SVGA color monitor
- 10-bay vertical case
- MS-DOS, Windows for Workgroups, Microsoft Mouse
- Lotus SmartSuite

Pentium-90 $3795
Pentium-100 $3995

Best MM Supreme:

The above system modified to include:

- 24MB RAM
- 1GB local bus IDE hard drive
- Altec Lansing high-power speakers

DX4-100 $3195

Package #3:

- 8MB RAM
- 350MB IDE hard drive
- Internal 3.5" 1.44MB floppy drive
- Dual-scan color VGA 10.3" display
- Custom carrying case
- Extra battery
- MS-DOS, Windows for Workgroups
- Lotus Organizer
- 8.9" x 11.7" x 1.9"; 6.3 lbs.

It's As Easy As:

1. Choose the ZEOS system package you want. (A sampling of our *Computers Now!* packages is shown at left.)
2. For same-day shipping, call ZEOS at 800-554-7172 before 1 p.m. Central Time, Monday-Friday.
3. Upon credit approval, we'll ship your system *the same day you order!*

Our Guarantee:

If we accept your order for immediate shipment and fail to ship your system under the conditions outlined, we will ship it *at our expense* as soon as it is ready.*

Need A Bigger Monitor?

We can upgrade your *Computers Now!* desktop or vertical system with a larger monitor–and still ship it the same day you order!*

800-554-7172
24 Hours a Day

ZEOS INTERNATIONAL, LTD.

Fax Orders: 800-362-1205 or 612-362-1205 Phone Orders: Outside U.S. and Canada: 612-362-1212, Government: 800-245-2449. ZEOS Information Systems, Inc. GSA# GS00K94AGS5176 Purchase Orders, MasterCard, VISA, Am Ex, Discover, Z-Card, COD and leasing programs.

Hidden Image

*Orders must be for Computers Now! configurations. we've listed just a sampling here. Since we continuously update this list of configurations, please call to confirm your system is on the list. This offer is good only as long as these pre-built systems remain in stock. Other ZEOS systems and custom configurations may take slightly longer–about a week. All orders are subject to credit approval. Monitor upgrades available on all desktop Computers Now! packages. Orders must be received by 1 p.m. Central Time, M-F

Purchase orders are subject to approval. Business leasing programs available. All prices, specifications and availability are subject to change without notice; call to confirm these and warranty details. Prices do not include shipping. Novell compatibility is Developer Tested Only. Novell makes no warranties with respect to this product. All products and company names are trademarks or registered trademarks of their respective holders. Intel Inside and Pentium Processor Logos are trademarks of Intel Corporation. ZEOS is a registered trademark, Computers Now! and Z-Card are registered servicemarks. Pantera, Ambra and ZEOS Meridian are trademarks of ZEOS International Ltd. © 1995 ZEOS International Ltd., 1301 Industrial Blvd., Minneapolis, MN 55413 USA. ZEOS is a publicly traded company (NASDAQ symbol: ZEOS)

PAN PCM-950B

CIRCLE 155 ON READER SERVICE CARD.

APPLICATION TESTS

TEST DESCRIPTION For the Application Launch and Application Search tests, we preinstalled Microsoft Encarta 94 on our test-bed using the option that consumed the smallest possible amount of hard disk space. We did this in order to stress the CD-ROM drive more and the hard disk less. We chose Encarta as a popular application representative of a multimedia title that searches an information database and plays and displays information in a variety of formats

For the Application Launch test, we measured the elapsed time from when we double-clicked on the Encarta icon to when the program actually started (that is, when the cursor reappeared on the Encarta main menu). For the Application Search test, we measured the time it took to find all entries that contained both video and animation components. We started timing when we clicked the Find button and stopped when the search was complete and the cursor reappeared

We also recorded the time it took to install CorelDRAW, Version 4.0, from a CD-ROM. We started timing when the "ready to install" message appeared and stopped when the "installation complete" message appeared

Lower scores represent better performance.	Application Launch (seconds)	Application Search (seconds)	CorelDRAW Installation (min:sec)
Quadruple-speed drives			
CD Porta-Drive T3501	12	6	4:17
Computer Connections CD Shuttle	12	6	4:15
Creative Labs OmniCD	13	8	5:09
Dynatek CDS654	12	6	4:13
Liberty 115CDT4xP	14	11	5:11
Mitsumi FX400	15	9	4:45
NEC MultiSpin 4Xi	17	14	4:14
Pioneer DRM-604X	17	16	4:42
Plextor 4PLeX PX-43CH	16	16	5:53
Toshiba XM-3501	14	11	3:49
Triple-speed drive			
NEC MultiSpin 3Xp Plus	19	9	5:47
Double-speed drives			
ALR Express CDE-1200	19	11	5:01
Apple CD300e Plus	18	10	4:49
APS MobilStor CD*	20	10	6:02
Aztech CDA268-03i	18	11	4:56
CD Porta-Drive T4100	18	10	5:31
Chinon CDS-535	17	9	4:47
Creative Labs OmniCD	17	9	5:09
Fidelity TransCD*	30	14	9:29
Goldstar GCD-R320B	17	9	5:12
Media Vision ReNO	17	9	4:50
Mitsumi FXN01DE	20	10	5:12
Mountain CD7	21	15	5:08
NEC CDR-260R	23	11	6:16
Panasonic LK-MC579BP	17	9	4:55
Panasonic LK MC509S	18	10	4:40
Philips CDD300	19	11	4:54
Sony CDU 55E	19	17	6:59
Sony CDU-55S (2.4-speed)	14	7	4:29
Toshiba XM-4100A	18	11	5:08

*This product was tested connected to the parallel port

DISCUSSION Because the Application Launch, Application Search, and CorelDRAW Installation tests are not multimedia tests, these scores generally reflect drive throughput, drive seek time, and combined hardware/software cache buffering. Though quadruple-speed drives proved faster on the whole, the 2.4-speed Sony CDU-55S matched or surpassed five or more of the quadruple-speed drives on each of the three application tests. The CD Porta-Drive T3501, the Computer Connections CD Shuttle PSM, and the Dynatek CDS654 were the fastest of the entire bunch on the Application Search test, each coming in at 6 seconds. The Toshiba XM-3501 installed CorelDRAW the fastest, at 3 minutes 49 seconds.

ed the external version, which was mounted in a heavy case with its own power supply; no external AC power brick is required.

Compared with other double-speed

AppleCD 300e Plus

ATAPI IDE and SCSI drives, the Apple's performance on our tests was above average. It dropped only three video frames playing back our Intel Indeo–compression AVI files. And CPU utilization was acceptable except when playing back our custom AVI file, which is meant for quadruple-speed drives. Loading CorelDRAW took only 4 minutes 49 seconds—19 seconds better than average for double-speed drives. Subjectively, video playback of standard edutainment applications was smooth, with very little frame dropping or audio fading.

The music played through either the twin RCA plugs on the back or the 1/8-inch stereo jack on the front was clean and undistorted and had clarity, warmth, and presence. One detail we found useful is that the volume-control wheel on the front of the drive has numbers to tell you the volume setting.

You don't need a caddy with the Apple; a motorized drawer loads and unloads your disks smoothly and safely. You can expect to use the Apple with any of the standard CD ROM formats, including CD-I, Kodak Photo CD, Red Book audio, and of course, Macintosh. As part of the price, Apple includes a Multimedia Starter CD for the Macintosh and Windows, plus a choice of 3 other CD apps out of a list of 30.

▶ **AppleCD 300e Plus.** List price: *Internal, $315; external, $369.* Apple Computer Inc., *One Infinite Loop, Cupertino, CA 95014; 800-776-2333, 408-996-1010; fax, 408-996-0275.*

Circle 449 on reader service card

APS Technologies Inc.

• APS MobilStor CD

BY BILL DYSZEL

If you need a CD-ROM drive to shuttle among several computers, APS Technologies offers an aggressively priced solution. The APS MobilStor CD ($299.95 direct) is an external double-speed parallel-port drive weighing 4.4 pounds. Its parallel-port connection means effortless

VB Power

ISBN: 1-56276-073-4
Price: $34.95

This innovative guide by Dan Appleman turns Visual Basic programmers into power users by illuminating the tools of the Windows Application Program Interface (API). Includes a time-saving disk that contains source code from the examples in the text, plus a specially designed dynamic link library (DLL).

Available at fine bookstores, or call 1-800-688-0448 ext. 8448

ZIFF DAVIS ZD PRESS

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APS MobilStor CD

installation, but keep in mind that the slow throughput of the parallel bus acts as a performance bottleneck. Indeed, while the APS's throughput score of 206 KBps was better than the 150 KBps of the other double-speed parallel-port drive reviewed here (Fidelity TransCD), it still rates well below the 300 KBps required to qualify for true double-speed performance. The MobilStor CD also had real difficulty playing full-motion video without dropping frames. Even on our least stringent Cinepak Video–compression multimedia playback test, the APS dropped 458 video frames—again, better than the 788 frames dropped by the Fidelity TransCD, but considerably worse than the zero frames dropped by most double-speed players. If you're primarily using text-based applications, the MobilStor CD is a decent solution, but don't consider it for multimedia edutainment applications. And for true portability, you'd probably prefer a drive that can run on batteries; the APS does not.

A single install routine on the included disk sufficed to install the APS unit on our test machines in about 5 minutes. One nice feature is that the APS has its own parallel port, which you can use to attach a printer or to daisy-chain another APS unit. The caddyless, double-speed drive accepts disks in an exceptionally sturdy drawer mechanism, and the APS draws power from an included external AC adapter. A small universal power supply ships with the product at no extra charge.

The APS supports all major CD-ROM formats, including CD-I, Multisession Photo CD, and Red Book audio. Music played from an audio CD was clear, clean, and undistorted, whether sampled through the 1/8-inch headphone jack on the front of the unit or through the two RCA jacks on the back.

The APS MobilStor CD isn't the right solution for everyone. But if having a transportable parallel-port drive is worth the performance tradeoff, the MobilStor CD might be right for you.

▶ **APS MobilStor CD.** List price: *$299.95 (includes AC adapter, DOS and Windows drivers).* APS Technologies Inc., *6131 Deramus Ave., P.O. Box 4987, Kansas City, MO 64120-0087; 800-677-3628, 816-483-1600; fax, 816-483-3077.*

Circle 450 on reader service card

CD Technology Inc.

• CD Porta-Drive T3501
• CD Porta-Drive T4100

BY TED NEEDLEMAN

Now that CD-ROM drives are on just about every new desktop PC, portable users are looking for ways to run CDs on the road. CD Technology offers two solutions: the quadruple-speed CD Porta-Drive T3501 ($500 list, $350 street for the external version) and the double-speed CD Porta-Drive T4100 ($400 list, $300 street). While neither qualifies as an ideal portable solution, the T4100 comes closer than most so-called portable drives.

To their credit, both drives offer a choice of two connections: SCSI-to-parallel and straight SCSI. A SCSI-to-parallel connection means quick, easy installation, an important feature when you're on the road. Unfortunately, such a connection also results in poor performance due to the bottleneck caused by the slow throughput of the parallel bus. Connecting to a standard ISA SCSI controller card results in better performance but complicates installation, since a SCSI card is required wher-

CD Porta-Drive T4100, CD Porta-Drive T3501

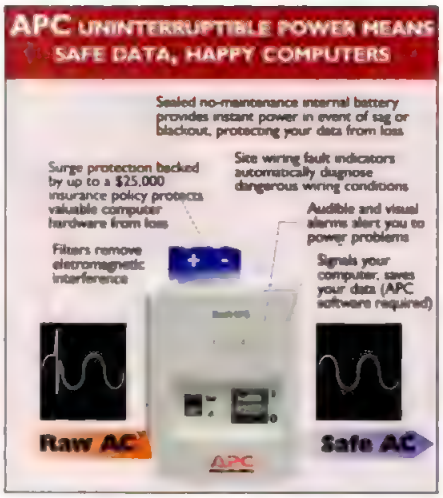
IT'S NOT IF. IT'S WHEN.

486, Pentium, PowerMac...
No matter how fast your PC is, it can't outrun a power problem
(Get Uninterruptible...starting at $119)

Just don't have the time for power problems on your PC? Don't worry. They'll always make the time for you. It's not if a power problem will occur, but when. Due to household appliances, poor wiring, bad weather or even other office equipment, power problems are as inevitable as death and taxes.

IN THE NEXT THREE MONTHS, MORE THAN 30,000,000 PCs WILL BE HIT BY POWER PROBLEMS...

In fact, you have better odds of winning the lottery than of escaping the sting of power problems on your PC. One study discovered a typical PC is hit over 100 times a month, causing keyboard lockups, hard drive damage, and worse. And since sags and blackouts represent more than 85% of power problems likely to hit your computer, standard surge suppressors are literally powerless to protect you. And a study in a recent *PCWeek* showed that the largest single cause of data loss is bad power, accounting for almost as much data loss as all other causes combined.



APC Uninterruptible Power Supplies provide instant battery backup to protect your data from loss and your hard drive from damage. Units are even backed by up to $25,000 in lifetime surge protection insurance.

PROTECT YOURSELF BEFORE YOU KICK YOURSELF...

Get instantaneous battery backup power from an APC Uninterruptible Power Supply and prevent keyboard lockups, data loss, and hard disk crashes. Surge protection performance is even backed by up to a **$25,000 Lifetime Equipment Protection Guarantee.**

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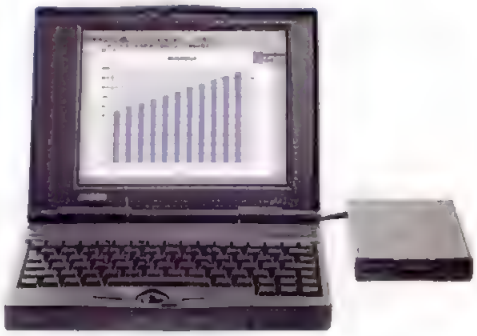

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CIRCLE 012 ON READER SERVICE CARD

20 Disks to Make Your Drive Spin

By John R. Quain

Finally, CD-ROM software developers have learned the three most important words in creating a CD-ROM: content, content, content. These 20 titles are some of the most informative and entertaining disks available. For a more complete review, including several business-oriented titles, see "The Top 100 CD-ROMS," September 13, 1994.

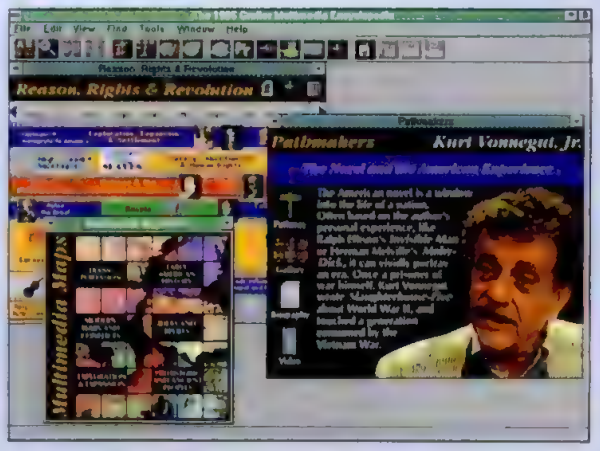
Reference and More

1995 Grolier Multimedia Encyclopedia for Windows With 33,000 articles from the hardcover edition—often written by experts in their fields—Grolier has always favored substance over form. But now the 1995 edition includes snazzier elements that are more worthy of the multimedia moniker. Souped-up, point-and-click time lines and a new Pathmakers section with narratives from people such as Stephen Jay Gould and Kurt Vonnegut, Jr., make this one the essential multimedia encyclopedia. ($149.95; Grolier Electronic Publishing Inc., 800-285-4534.)

Popular Mechanics New Car Buyers' Guide-95 The best thing about this title is that you can search through its compendium of over 800 vehicles using your own list of desired features (number of doors, safety features, and so on). It includes a calculator for loan-versus-lease deals, as well as buying tips for first-time shoppers. ($29.95; Books That Work, 800-242-4546.)

Taxi for CD-ROM The multitude of map and guidebook CD-ROMs makes this a crowded arena. Taxi distinguishes itself by including not only detailed maps of five major American cities (New York, Chicago, Los Angeles, San Francisco, and Washington) but also Zagat's restaurant and hotel guides for each city. It's a great tool for business travelers and includes route information so you don't get taken for a ride. ($79.95; News Electronic Data Inc., 800-439-8294.)

Wines of the World Based on *The Companion to Wine*, edited by Frank Prial, this disk offers an ebullient introduction to the pleasures of Bacchus. Intended for the novice, it offers wine-tasting tips, label explanations, and descriptions of wine regions from the Napa to the Rhone valley. There are even recorded pontifications from such famous vintners as Michel Chapoutier. ($49.95; Multicom Publishing Inc., 800-850-7272, 206-622-5530.)



1995 Grolier Multimedia Encyclopedia for Windows lets you find the articles you need by clicking on time-line items.

Culture

Microsoft Art Gallery for Windows Art Gallery brings the best of the collection of the National Gallery in London to your computer screen. Stylishly designed and carefully presented, Art Gallery includes not only images of the paintings themselves but also brief biographies, a historical atlas, and four narrated tours. ($59.95; Microsoft Corp., 800-426-9400.)

Microsoft Cinemania '95 for Windows This is the best compendium of movie views and reviews available on-disk. The 1995 version comes with an improved search engine, a list of suggestions for video rentals, and over 300 new reviews. The approximately 20,000 reviews herein are written by Roger Ebert, Pauline Kael, and Leonard Maltin. Each movie listing includes credits, awards, and the MPAA rating. The 20 or so video clips are the last thing you'll notice. ($59.95; Microsoft Corp., 800-426-9400.)

Opera Guide with CD-ROM This disk, based on one of the most authoritative guides to opera, contains over 3 hours of compressed music samples, plus biographies, photos, and geographical and contextual data covering everyone from Claudio Monteverdi to Philip Glass. The entire text and photos from the original 1,300-page book, *The Viking Opera Guide*, are exquisitely presented in this electronic form. ($99.95; Penguin USA, 800-253-6476.)

Science and Nature

A.D.A.M. The Inside Story The company behind this disk has been creating anatomical illustrations for the medical community for over a decade. A.D.A.M. lets you step through all the subcutaneous layers right down to the skeleton, or play over 4 hours of animation (narrated by the wisecracking Adam) with detailed explanations of such human functions as reproduction and snoring. The male and female figures come with or without fig leaves—at parental discretion. ($59.95; A.D.A.M. Software Inc., 800-408-2326, 404-980-0888.)

In the Company of Whales You can learn about lobtailing and echolocation, go on a whale-watch cruise, or just enjoy the beautiful presentation. Created by the same folks responsible for the Dis-

covery Channel, this disk is more cinematic than bookish, but there's a lot here. You can even ask predetermined questions and receive videotaped answers from some of the world's leading experts. ($49.95; Discovery Communications Inc., 800-336-2947.)

RedShift RedShift is the next-best thing to the planetarium. Serious amateur astronomers will appreciate its detailed sky charts, while armchair astronauts will enjoy the animated fly-bys of planets and galaxies. And *The Penguin Dictionary of Astronomy* is included, just in case you get lost. ($64.95; Maxis, 800-336-2947.)

History

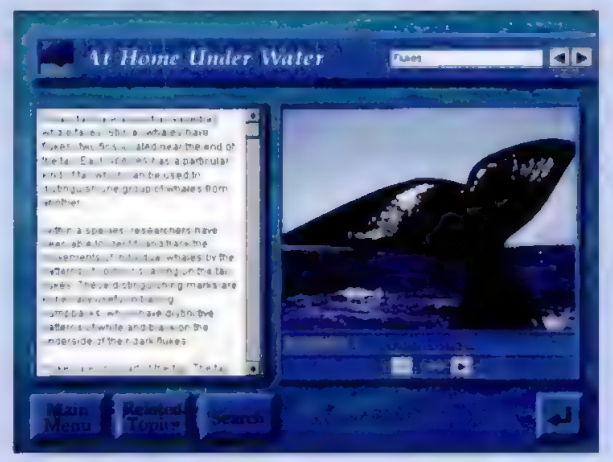
The Anglo-Saxons The Anglo-Saxons, based on material from the British Museum, livens up an otherwise dusty subject. Using animated maps and historical anecdotes, this title is so successful at documenting and piecing together the post-Roman culture and history of Great Britain that it makes even Beowolf engaging. ($59.95; Cambrix Publishing Inc., 800-992-8781.)

The Haldeman Diaries The ex–ad man and White House chief of staff covers his time in the capital with text, dictated audio clips, videos, and photographs. The diaries offer excellent insights into one of Nixon's men who obstructed justice, as well as biased profiles that treat Liddy harshly while failing to mention Haldeman's own criminal conviction. ($69.95; Sony Imagesoft, 800-922-7669.)

Her Heritage: A Biographical Encyclopedia of Famous American Women Taking an often neglected approach to history, Her Heritage covers over 1,000 famous women in U.S. history. The biographical sketches include everyone from Lucille Ball to Elizabeth Blackwell (the first woman to graduate from an American medical school). Brilliant graphics and creative layouts enhance this thoughtful and informative title, edited by Robert McHenry, editor-in-chief of *Encyclopedia Britannica*. ($49.95; Pilgrim New Media Inc., 617-491-7660.)

Children

Arthur's Birthday Arthur's Birthday, written by Marc Brown, is an engaging and humorous tale illuminating the sociology of the schoolyard. It's just one of the talking, animated Living Books series, all of which are winners. ($39.95; Broderbund Software Inc., 800-521-6263.)



In the Company of Whales includes videos of jumping whales and audio clips of whale sounds.

The Farm The Farm is a talking introduction to agrarian life for youngsters 3 to 8. Entertaining characters explain everything from the animals on a farm to how a silo works. Old MacDonald never covered so much ground. ($34.95; Humongous Entertainment, 206-485-1212.)

Something Completely Different

4 Paws of Crab 4 Paws of Crab is more than a cookbook; it not only explains basic Thai recipes and whether or not you should eat Kaffir lime leaves, it also provides contemporary and historical insights into Thailand itself. Told from the point of view of two cultures (American and Thai), 4 Paws of Crab is a vibrant and rich entree to an exotic culture. ($44.95; Live Oak Multimedia Inc., 800-454-7557, 510-654-7480.)

From Alice to Ocean Alice is a place (Alice Springs, to be exact), and it's situated in the Australian outback. From this spot, Robyn Davidson set out on a 1,700-mile journey on foot and camelback to explore terrain for the National Geographic Society. Her sojourn is recreated using every resource available, and the disk is a mesmerizing video, photo, and graphic feast—part travelog, part lesson in the wilds of the outback, part photo expedition. ($69; Claris Corp., 800-325-2747.)

Monty Python's Complete Waste of Time Make way for pure, unmitigated whimsy and satire from the madcap Monty Python comedy troupe. The disk includes over 30 video clips from the TV series, plus games and new material from the original cast members. Ask for help and you'll get abuse. And it's not a complete waste of time: There are lots of computer gimcracks like Python wallpaper and screen savers. ($60; 7th Level Inc., 214-437-4858.)

Myst Myst is already a CD-ROM classic, and you owe it to yourself to explore its lush, painstakingly illustrated Jules Verne–style world. It's the progenitor of truly interactive multimedia entertainment: You don't shoot monsters or watch digitized video clips; instead, you walk through eerily enticing worlds, throwing levers and uncovering clues to the Shakespearian plot. ($54.95; Broderbund Software Inc., 800-521-6263.)

Star Trek: The Next Generation Interactive Technical Manual Trekkies won't be able to resist this title, a virtual walkthrough of the USS *Enterprise NCC 1701-D*. Commander Riker (Jonathan Frakes) narrates a guided tour, and you can swoosh through the ship's corridors on your own to explore areas like the Holodeck and 10 Forward. ($69.95; Simon & Schuster Interactive, 800-983-5333.) □

ever you install the drive, and SCSI installations can be problematic. A PCMCIA SCSI card provides the best combination of performance and portability for the road—provided, of course, your laptop offers a PCMCIA slot and you don't run into any PCMCIA compatibility problems.

At 3 pounds and 2 by 6 by 9 inches (HWD), the quad-speed T3501 is the larger and heavier of the two units we tested, qualifying more as a transportable device than one which is truly portable. It comes with an AC power brick that, at 1 pound and 6.4 by 2 by 3 inches, adds considerable weight and bulk. Operation from a battery pack is not an option. Another disadvantage in this portable drive: It requires a caddy—yet another element to lug with you on the road, though a caddy configuration does let you run the drive on its side.

Performance was as expected: When tested using the parallel connection (results not shown), the T3501 barely achieved single-speed performance, and multimedia playback results were abysmal, with hundreds of dropped video frames. If you plan to use a parallel connection, there doesn't seem to be any reason to pay extra for a quadruple-speed configuration. Test results using our Adaptec AHA-1542CF SCSI adapter were considerably improved, but mixed: Sequential- and random-seek scores were better than average, as were scores on our multimedia search and CorelDRAW installation tests; but when it came to our objective multimedia playback tests, the T3501 was among the lesser performers of the quadruple-speed drives. Subjectively, multimedia applications ran smoothly with no noticeable breaks.

The T4100, at 1 pound and 1 by 6 by 8 inches, is considerably smaller and lighter than the T3501, and can be operated from a small AC power cube or even an optional portable battery pack rather than the much larger brick-style supply the T3501 uses. Unlike the T3501, it is a caddyless design.

Again, parallel performance was just barely single-speed-class, while performance with a SCSI adapter was considerably improved, though the results for the CorelDRAW application launch test were below average.

Both Porta-Drives are incomplete portable solutions. The T3501 is bulky, and many users will not be able to take advantage of its quad-speed performance on the road. The small, lightweight, battery-powered T4100 makes a good choice if you need a truly portable drive and your laptop has a PCMCIA slot.

Chinon CDS-535

▶ **CD Porta-Drive T3501.** List price: *External, $600; internal $500.* **CD Porta-Drive T4100.** List price: *$400.* Options: *Battery pack, $100.* CD Technology Inc., *764 San Aleso Ave., Sunnyvale, CA 94086; 408-752-8500; fax, 408-752-8501.*

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Chinon America Inc.

• Chinon CDS-535

BY STEVEN C. M. CHEN

Last year's Editors' Choice, the Chinon CDS-535, is still a strong contender among this year's crop of double-speed drives. At a street price of $279, including SCSI controller, it is also considerably less expensive than it was last year and makes a good choice for a double-speed workhorse.

With a rated access time of only 220 ms and a large 256K buffer, the CDS-535 should be fast. While it wasn't the top performer among the double-speed drives we tested, its multimedia playback scores were consistently above average. The CDS-535 dropped only 139 video frames on our 16-bit video compression and 31 frames on our Intel Indeo multimedia playback test, compared with the averages for nonparallel double-speed drives: 172 and 45, respectively. CPU utilization scores were also consistently better than average. On subjective tests, multimedia playback was smooth and uneventful and audio CD playback was perfectly acceptable. The Red Book audio connector on the drive is nonstandard, but Chinon includes a cable with the drive that works with most sound cards.

Installation was easy. We tested the drive with the 8-bit NCS-250-SC SCSI-2 interface provided by Chinon. The included DOS-based installation utility installed appropriate drivers and updated AUTOEXEC.BAT and CONFIG.SYS files automatically. No CD-ROM application software is included with the drive package.

An external version of the CDS-535, the CDX-535, is also available for $100 more than the internal version. Chinon plans to offer a quad-speed drive, but it wasn't ready in time for this review. An ATAPI version of the quad-speed, the CDS-545, should be shipping by the time you read this review. Its street price is predicted to be under $200. A SCSI-version, CDX-545, will follow in a couple of months. Buyers looking for a basic double-speed drive that delivers solid performance should consider the CDS-535.

▶ **Chinon CDS-535.** Estimated street price: *Internal, $279; external, $379.* Chinon America Inc., *615 Hawaii Ave., Torrance, CA 90503; 800-441-0222, 310-533-0274; fax, 310-533-1727.*

Circle 452 on reader service card

Computer Connections America

• CD Shuttle PSM

BY LEON ERLANGER

The CD Shuttle PSM, with an external configuration that is complete with a handle and a choice between fast EPP and standard SCSI connections, almost succeeds as a transportable quadruple-speed drive. Unfortunately, the CD Shuttle PSM's high street price of $739 ($799 list) and its difficult installation prevent us from recommending it with much enthusiasm.

Computer Connections America emphasizes that its forte is providing peripheral equipment that easily connects to a

CD Shuttle PSM

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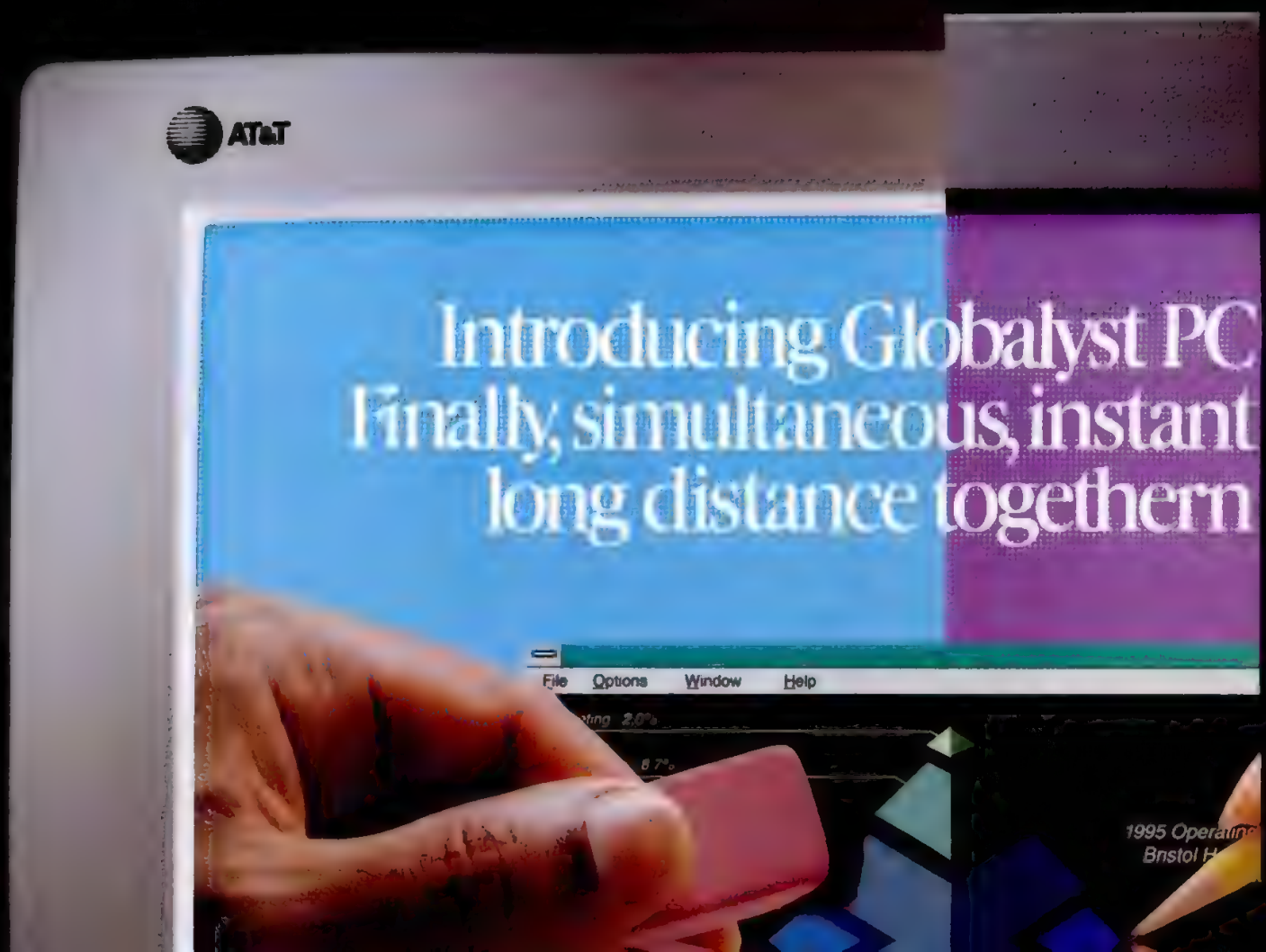
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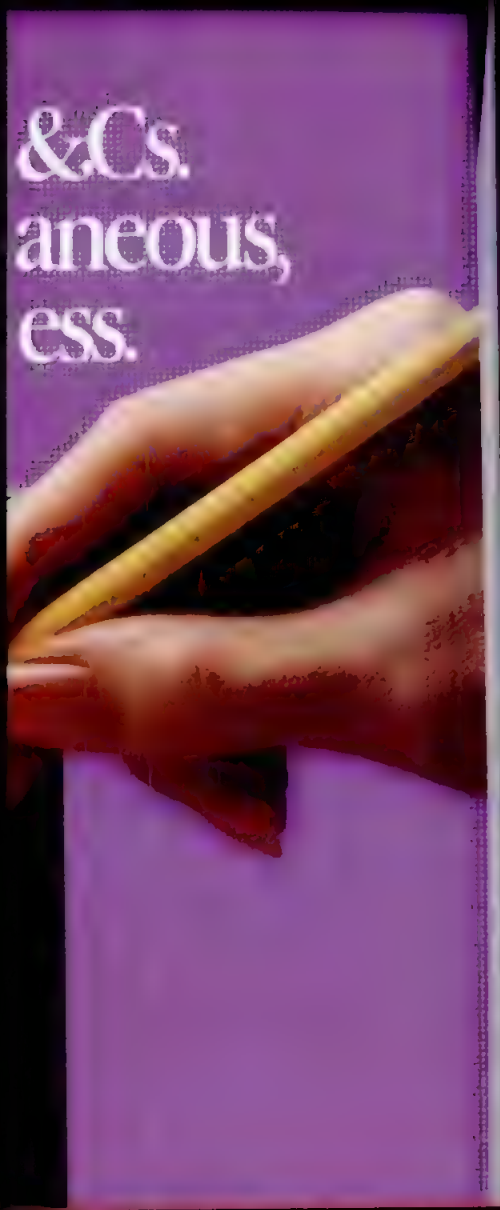

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Networking CD-ROM Drives

By James Karney

There are three approaches for providing CD-ROM access across a network:

- *Dedicated CD-ROM server.* Users access a networked PC containing multiple CD-ROM drives, which is used exclusively for this purpose.
- *Combination file server/CD-ROM server.* Users access CD-ROM drives in the network file server.
- *Peer-to-peer.* Users are allowed shared access to CD-ROM drives on their workstation PCs.

The method you choose depends on the size of your network and on your network operating system. In a series of informal tests conducted by PC Labs, we managed to connect and share CD-ROMs effectively with all the methods we tested, but the programs and disks we could access varied with each one.

SCSI DRIVES WORK BEST

Virtually any CD-ROM drive you can attach to a desktop PC can be used as a network drive. As a practical matter, you'll want to use SCSI drives rather than proprietary- or IDE/ATAPI-interface drives, because CD-ROM drives on the network are a lot like peanuts: You can't stop with just one, and a SCSI adapter can handle seven devices—with fast throughput. Also, you wouldn't want to use multidisk CD changers, since you can access only one of their six or seven platters at a time.

To access the CD-ROM's file structure, many operating systems require some form of translation utility or redirection. The most popular is MSCDEX, the Microsoft MS-DOS CD-ROM Extensions, which ships with DOS 6.x and takes up about 35K of RAM—5K if you load it into high memory. Not all CD-ROM applications require you to load MSCDEX; some perform redirection on the fly. We found some applications would run on a networked CD-ROM, but the disk's data could not be recognized without the client PC running MSCDEX locally.

For networked CD-ROM drives, multimedia files pose particular problems. A multimedia file played over a busy network might take three times as long to complete, and you'll get skipped or garbled frames—if it runs at all. You might get the sound coming out of the server or piped to your PC, or you might find the sound is ignored.

Virtually any CD-ROM drive you can attach to a desktop PC can be used as a network drive.

CD DRIVES UNDER NETWARE

Both NetWare 3.12 and 4.01 allow you to mount—that is, to insert and then recognize—a CD-ROM volume directly on an existing dedicated file server by using Novell's bundled NetWare Loadable Modules (NLMs). One drawback is the time it takes (several minutes) to mount and unmount the volume. The CD-ROM reads can clog a busy server, and frequent disk changing can eat up staff time and limit ready access to the drive.

Sensing opportunity, several third-party suppliers have offered enhancements for NetWare.

Corel's Corp.'s CorelSCSI Network Manager software ($595; 800-836-7274, 613-728-8200) is an excellent choice if you want to network existing CD-ROM drives and adapters. An NLM is loaded on the server, and a driver is installed on each workstation client. The NLM is used to mount and unmount volumes and set the amount of dedicated CD-ROM cache. The administrator must physically mount the disk. Users access a database created by the NLM from the CD-ROM; this speeds up operation and delivers extra security.

Micro Design International (MDI) uses a similar technique with its SCSI Express 600CDX software ($645-$795; 800-228-0891, 407-677-8333). It requires an NLM loaded on the server, and the drive's volumes must be mounted there. MSCDEX is not required on clients. MDI also sells CD-ROM drives housed in interlocking external enclosures, or CD-ROM drives mounted in towers.

Online Computer System's Opti-Net ($795 to $1,795; 800-922-9204, 301-428-3700) uses redirection to turn a PC into a dedicated CD-ROM server, which offers excellent security and management. This approach allows clients access to a CD-ROM on the server

user's parallel port. Indeed, even though the drive comes with a SCSI connection, the CD Shuttle's documentation covers only parallel installation. What is even more surprising, however, is that the EPP installation proved more difficult than the SCSI installation, which was easily accomplished using our standard Adaptec AHA-1542CF SCSI adapter and EZ-SCSI software. We tried to install the CD Shuttle using our test-bed's fast parallel port, then an EPP add-in card from FarPoint Communications—to no avail. We finally got the drive to work with Computer Connections America's own EPP card, but only after substituting DOS's MSCDEX, Version 2.23, for the CorelCDx, Version 1.001A provided by Computer Connections America's installation software. We question the value of an EPP installation that is not quick, easy, and universally compatible.

Once we got the drive working, performance was a mixed bag. Throughput results were fine in both SCSI (shown) and EPP modes (not shown); and multimedia search and CorelDRAW installation results were quite good. Even in SCSI mode, however, the CD Shuttle was the second-worst drive among our quad-

without loading MSCDEX locally, thus reducing local overhead. If you keep the same disks loaded all the time, then setup demands are not a problem, and the path and permissions can be configured just once.

Microtest's Discport ($795) is a dedicated CD-ROM server that uses an NLM but does not reside on the server. It is a box about the size of a paperback novel that supports up to seven CD-ROM drives without requiring MSCDEX. There is no need to load drivers on the clients; instead, you load the NLM on the server and then map the drives. A drag-and-drop interface makes it easy to mount or manage volumes from the client.

Plextor (800-886-3935, 408-980-1838) is planning a CD-ROM tower that can be directly cabled into a network and offers its own redirection without an NLM. Plextor says the quad-speed drives will be fast enough to allow more than one user to access the same disk simultaneously.

CD DRIVES UNDER WINDOWS NT

Microsoft Windows NT is an example of how peer-to-peer CD-ROM sharing should work. The server administrator or a workstation user "shares" a locally installed CD-ROM drive, then sets permissions. Any approved user can immediately map drives to a local PC. This is a great low-volume solution. Do make sure your CD-ROM drive is NT-compatible—most but not all are. Of course, NT can also be used with dedicated CD-ROM servers, for larger workgroups. □

speed models at dropping video frames on our multimedia playback tests; only the Plextor 4PLeX PX-43CH was worse due to an inability to read our CD-R disk properly. A bright spot: While we haven't published results for performance using the EPP connection, it was the best of any of the parallel-port drives we reviewed: not dramatically worse than the drive's SCSI performance.

The CD Shuttle is caddy-based. Its 2.3- by 6.5- by 13.5-inch measurements and 7-pound weight, including internal power supply, disqualify it from portable status, but it is definitely transportable. The lack of audio connectors means you have to connect it to your sound card through the headphone jack. Red Book audio performance is decent but has some background hiss.

▶ **CD Shuttle PSM.** List price: *$799.* Computer Connections America Inc., *19A Crosby Dr., Bedford, MA 01730; 800-438-5336, 617-271-0444; fax, 617-271-0873.*

Circle 453 on reader service card

Creative Labs Inc.

• Creative Labs OmniCD
• Creative Labs Omni4x

BY JONATHAN HILL

Creative Labs—best known for its industry-standard Sound Blaster sound boards—offers two reasonably priced CD-ROM drive kits. Both drives are targeted primarily at owners of Creative Labs' audio products, but neither requires the presence of a Sound Blaster card. The Creative Labs OmniCD ($249.95 list, $180 street) is a double-speed caddyless drive made by Panasonic that uses the proprietary CD-ROM drive interface found on Sound Blaster Pro and Sound Blaster 16 cards. It also comes with its own proprietary controller card in case you don't happen to own a Creative Labs sound card. The caddy-based Creative Labs Omni4x ($549.95 list, $449 street), which replaces the recently discontinued Omni3x, is a SCSI-2–compatible unit based on a faster NEC CDR-511 internal quad-speed drive.

Unfortunately, while not the worst performers, both Creative Labs drives showed below-average results for their respective classes when it came to CPU utilization and video frames dropped on our multimedia playback tests. Subjectively, however, multimedia applications played back smoothly with no visible problems. Scores on application and throughput tests hovered around average, considering each product's rated speed.

Both drives were reasonably easy to install. Since the Omni4x did not come with a SCSI card, we installed it using our Adaptec AHA-1542CF SCSI controller and Adaptec's EZ-SCSI software, which made for an easy installation. Installing the OmniCD with its proprietary connector was easy, but with standard ATAPI IDE solutions available from several vendors, we question the value of a proprietary installation in the future. Creative Labs' DOS-based installation program lets you choose among the standalone card, Sound Blaster Pro, and Sound Blaster 16–based installations. Neither drive has a standard analog audio connector. Instead, Creative Labs provides a cable that connects the output on the back of the interface card to an input channel on your sound card. This arrangement reduces the number of available channels for other inputs, and it required some tinkering with mixer software in order to get adequate sound quality from the Media Vision Pro Audio Spectrum cards that we used in our test-beds.

Both units ship with an impressive inventory of bundled software extras, including Digital Morph and Kai's Power Tools from HSC Software, Aldus PhotoStyler, Aldus Gallery Effects, Altamira Composer, and Grolier Multimedia Encyclopedia.

Creative Labs OmniCD, Creative Labs Omni4x

▶ **Creative Labs OmniCD.** List price: *$299.95.* **Creative Labs Omni4x.** List price: *$549.95.* Creative Labs Inc., *1901 McCarthy Blvd., Milpitas, CA 95035; 800-998-5227; fax 408-428-6611.*

Circle 454 on reader service card

Dynatek Automation Systems Inc.

• Dynatek CDS654

BY JONATHAN HILL

Based on the fast Toshiba XM3501 drive mechanism, the quadruple-speed Dynatek CDS654 showed mixed results on our per-

▶ SUMMARY OF FEATURES CONTINUES

CD-ROM Drives

Products listed in review order ■ = YES □ = NO	ALR Express CDE-1200	Aztech CDA268-01I	AppleCD 300e Plus	APS MobilStor CD	CD Porta-Drive T2801	CD Porta-Drive T4100	Chinon CDS-535	CD Shuttle PSM
List price or estimated street price:								
Internal drive	$149.00 (street)	$159.00 (list)	$315.00 (list)	N/A	$400.00 (list)	N/A	$279.00 (street)	N/A
External drive	N/A	N/A	$369.00 (list)	$299.95 (list)	$500.00 (list)	$400.00 (list)	$379.00 (street)	$799.00 (list)
Interface card	Optional	■	□	N/A	□	N/A	■	N/A
General Features								
Speed	2x	2x	2x	2x	4x	2x	2x	4x
Data transfer rate (kilobytes per second)	307	300	342	308	900	300	300	600
Buffer size	128K	128K	256K	250K	256K	64K	256K	256K
Average access time (milliseconds)	350	350	290	329	150	250	229	150
Types of connections	ATAPI IDE	ATAPI IDE	SCSI	Parallel	SCSI, SCSI/parallel	SCSI, SCSI/parallel	SCSI	SCSI, SCSI/parallel
Mechanism manufacturer	Philips	Philips	Matsushita	Sony	Toshiba	Toshiba	Chinon	Toshiba
Mechanism model	CDM12.4	CDM12.4	CR-503-B	CDU-55D	3501	4100	CDS-535	3501E
Dimensions of external version (HWD, in inches)	N/A	N/A	2.3 x 6.2 x 13.1	2 x 7 x 11	2 x 6 x 9	1 x 6 x 8	2.2 x 6 x 9.8	2.3 x 8.5 x 13.5
Weight of external version (pounds)	N/A	N/A	5.7	4.4	3.0	1.0	5.5	7.0
Requires caddies	□	□	□	□	■	□	■	■
Power indicator/Busy indicator	■■	□■	■■	■■	■■	□■	■■	■■
Manual eject/Software eject	□■	■■	■■	■■	■■	□□	■■	■□
Headphone jack/Volume knob	■■	■■	■■	■■	■■	■■	■■	■■
RCA jacks/Red Book audio connector	N/A■	N/A■	■□	■N/A	■■	■N/A	□■	■N/A
Customer Support								
Toll-free technical support	■	■	■	■	□	□	■	■
Telephone support hours (eastern time)	9:00–8:00 M–F, 9:00–4:00 Sat.	11:00–8:00 M–F	9:00–8:00 M–F	9:00–8:00 M–F, 10:00–6:00 Sat.	12:00–7:30 M–F	12:00–7:30 M–F	11:30–8:00 M–F	9:00–5:30 M–F
24-hour BBS	■	■	□	■	■	□	■	■
Warranty coverage	1 year	1 year	1 year	1 year	1 year	1 year	1 year	1 year

N/A—Not applicable: The product does not have this feature.

formance tests. Sequential-seek scores were among the best of the lot, as were the CorelDRAW installation and multimedia search results. When it came to our multimedia playback tests, however, the Dynatek's scores were below average for a quadruple-speed drive, with 164 video frames dropped on our 16-bit Video 1 compression test (compared with an average of 120 for quadruple - speed drives) and 502 frames dropped in playing back our rigorous custom AVI file (compared with an average of 416). CPU utilization playing our custom AVI file was a high 71 percent. Subjective testing showed smooth playback of standard multimedia applications, however. The external version of the Dynatek that we tested carries an estimated street price of about $450, but internal units should be available for about $100 less.

Dynatek CDS654

Documentation was a bit sparse. Unlike the manual for Apple Macintosh versions of the product, the CDS's PC manual provides no information concerning software setup for the Dynatek. Fortunately, the external quadruple-speed drive that we tested came with an Adaptec AHA-1542CF SCSI adapter and Adaptec's excellent EZ-SCSI software, so installation of the drive's ASPI managers and device drivers went smoothly. The company also provides Adaptec's ASPI Manager for NetWare, so you can set up the unit as a network CD-ROM drive.

Back-mounted RCA jacks, in addition to the standard headphone connector in the front of the unit, provide a nice touch, making it easy to route audio CD output to your existing stereo system. The caddy-based system includes a well-designed dust cover, and the drive incorporates an auto-cleaning feature.

▶ **Dynatek CDS654.** List price: *External, $599; internal, $499 (with Adaptec AHA-1542CF 16-bit SCSI controller, SCSI cable, active SCSI terminator); optional SCSI interfaces, $90 to $350.* Dynatek Automation Systems Inc., *200 Bluewater Rd., Bedford, Nova Scotia, Canada B4B 1G9; 800-461-7078, 416-636-3000; fax, 416-636-3011.*

Circle 455 on reader service card

Fidelity International Technologies

• Fidelity TransCD

BY JACQUELINE EMIGH

Although CD-ROM drives don't look all that different from audio CD players, they can take a lot longer to set up. Fidelity's parallel-port–based TransCD ($329

SUMMARY OF FEATURES

CONTINUES

Products listed in review order ■ = YES, □ = NO List price or estimated street price	Creative Labs OmniCD	Creative Labs Omni4x	Dynatek CDS654	Fidelity TransCD	Mitsumi FX400	Mitsumi FXN01DE	Goldstar GCD-R320B	Liberty 115CDT4xP
Internal drive	N/A	$549.95 (list)	$499.00 (list)	N/A	$269.00 (list) (for Gateway customers)	$199.00 (list) (preinstalled in IBM PCs)	$239.95 (list)	N/A
External drive	$249.95 (list)	N/A	$599.00 (list)	$399.00 (list)	N/A	N/A	N/A	$699.00 (list)
Interface card	■	□	Optional	N/A	N/A	N/A	□	Optional
General Features								
Speed	2x	4x	4x	2x	4x	2x	2x	4x
Data transfer rate (kilobytes per second)	300	600	600	300	600	300	300	600
Buffer size	64K	256K	256K	32K	128K	128K	64K	256K
Average access time (milliseconds)	350	240	150	250	250	310	250	150
Types of connections	Proprietary	SCSI	SCSI	Parallel	ATAPI IDE	ATAPI IDE	SCSI	S...S SCSI, Parallel
Mechanism manufacturer	Panasonic	NEC	Toshiba	Fidelity	Mitsumi	Mitsumi	Goldstar	Toshiba
Mechanism model	CR563	CDR-511	XM3501 B	TCD2X-P	FX400	FXN01DE	GCD-R320B	XM3501
Dimensions of external version (HWD, in inches)	2.3 x 8 x 11.3	N/A	2.5 x 8.5 x 10.9	2 x 6 x 11.5	N/A	N/A	N/A	1.9 x 6.8 x 9
Weight of external version (pounds)	4.8	N/A	3.0	5.0	N/A	N/A	N/A	4.2
Requires caddies	□	■	■	□	□	□	□	■
Power indicator/Busy indicator	■ ■	■ ■	■ ■	■ ■	□ ■	□ ■	□ ■	■ ■
Manual eject/Software eject	■ ■	■ ■	■ ■	■ □	■ ■	■ ■	■ ■	■ ■
Headphone jack/Volume knob	■ ■	■ ■	■ ■	■ ■	■ ■	□ ■	■ ■	■ ■
RCA jacks/Red Book audio connector	■ N/A	N/A ■	■ ■	■ N/A	N/A ■	N/A ■	N/A ■	■ N/A
Customer Support								
Toll-free technical support	□	□	■	□	■	■	■	□
Telephone support hours (eastern time)	9:00 A.M. 1:00 A.M., 7 days	9:00 A.M. 1:00 A.M., 7 days	4:00 A.M. 8:00 P.M. M–F	9:00–5:30 M–F	7:00 A.M. 1:00 A.M. M–F, 10:00–2:00 Sat	24 hours, 7 days	10:00–5:00 M–F	5:00 A.M. 2:00 P.M. M–F
24-hour BBS	■	■	■	■	■	■	□	■
Warranty coverage	1 year	1 year	2 years	1 year	1 year	2 year	1 year	1 year

N/A—Not applicable. The product does not have this feature.

street) stands out as an exception. It's a hardware installation that even the novice user can manage. The TransCD requires no interface card (proprietary or SCSI), so it can be used with virtually any notebook PC or with a desktop PC devoid of an available expansion slot. Weighing 5

Fidelity Trans CD

pounds (including power supply) and measuring 2 by 6 by 11.5 inches, this caddy drive is reasonably transportable, too.

Keep in mind, however, that what you gain in ease of use and portability you lose in performance, which is severely hampered by the slow throughput of the parallel bus. A throughput score of 150 KBps were closer to single-speed than double-speed, and the multimedia playback results were among the worst. Even on our least rigorous 8-bit Cinepak video compression test, the TransCD dropped 746 video frames, compared with zero for most non-parallel double-speed drives, and CPU utilization was an unacceptable 87 percent. Clearly, this drive is an adequate solution only for users of text-based CD applications.

A pass-through feature permits simultaneous use with a printer. The drive can also be daisy-chained with other TransCDs, or with Fidelity's TransDisk external hard disks, with up to four peripherals per port. TransCD is compatible with single-session and multisession Photo CD, with CD-I, and with CD-ROM XA. Fidelity also includes two free CD titles (which vary).

▶ **Fidelity TransCD.** List price: *$399.* Fidelity International Technologies, *215 Campus Plaza, Raritan Center, Edison, NJ 08837-3936; 908-417-2230; fax, 908-417-5994.*

Circle 456 on reader service card

Gateway 2000 Inc.

• Mitsumi FX400

IBM Personal Computer Co.

• Mitsumi FXN01DE

BY STEVEN C. M. CHEN

A growing number of CD-ROM manufacturers are gearing some of their products primarily toward secondary marketers. The Mitsumi FX400 and Mitsumi FXN01DE, originally from Mitsumi Electronics Corp., are such products. The FXN01DE is an ATAPI IDE double-speed CD-ROM found inside IBM's 300 series, 700 series, and Aptiva line. Its overall performance is acceptable, though video playback suffered. The FX400 is one of the first ATAPI IDE quad-speeds available, and it is used inside the Gate-

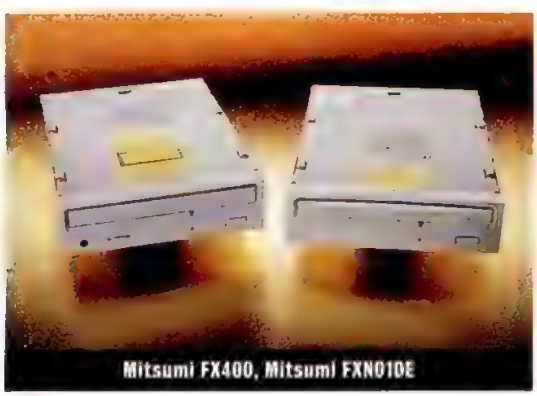
▶ SUMMARY OF FEATURES

CONTINUES

Products listed in review order ■ = YES □ = NO	ReNO Portable CD-ROM Player	Mountain CD7	NEC CDR-260R	NEC MultiSpin 3Xp Plus	NEC MultiSpin 4X	Panasonic LK-MC579BP	Panasonic LK-MC509S
List price or estimated street price:							
Internal drive	N/A	N/A	$125.00 (list) (preinstalled in Dell PCs)	N/A	$495.00 (street)	$249.00 (list)	N/A
External drive	$349.00 (list)	$649.00 (list)	N/A	$495.00 (street)	$595.00 (street)	N/A	$399.00 (list)
Interface card	Optional	N/A	N/A	■	■	■	□
General Features							
Speed	2x	2x	2x	3x	4x	2x	2x
Data transfer rate (kilobytes per second)	306	300	300	500	600	300	300
Buffer size	64K	64K	256K	256K	256K	256K	256K
Average access time (milliseconds)	180	380	320	240	220	280	280
Types of connections	SCSI	SCSI	ATAPI IDE	SCSI	SCSI	ATAPI IDE	SCSI
Mechanism manufacturer	Matsushita	Nakamichi	NEC	NEC	NEC	Matsushita	Matsushita
Mechanism model	Proprietary	2X CD drive	CDR-260R	NEC 3X	NEC 4X	CR57X	CR50X
Dimensions of external version (HWD, in inches)	1 x 6.3 x 10.3	3.7 x 7.8 x 12.8	N/A	2.2 x 6.1 x 10.1	3 x 6.9 x 13	N/A	2.3 x 6.2 x 12.4
Weight of external version (pounds)	1.2	4.1	N/A	4.6	6.4	N/A	5.7
Requires caddies	□	□	□	■	■	□	□
Power indicator/Busy indicator	■■	■■	□■	■■	■■	■■	■■
Manual eject/Software eject	■□	■■	■□	■□	■□	■■	■■
Headphone jack/Volume knob	■■	■■	■■	■■	■■	■■	■■
RCA jacks/Red Book audio connector	■ N/A	■ N/A	N/A ■	■ N/A	■■	N/A ■	■ N/A
Customer Support							
Toll-free technical support	■	□	■	■	■	■	■
Telephone support hours (eastern time)	9:00 A.M.–11:00 P.M. M–F; 11:00–7:00 Sat., Sun.	10:00–10:00 M–F	24 hours, 7 days	8:00 A.M.–8:30 P.M. M–F	8:00 A.M.–8:30 P.M. M–F	24 hours, 7 days	24 hours, 7 days
24-hour BBS	■	■	■	■	■	■	■
Warranty coverage	1 year	1 year	1 year	2 years	2 years	2 years	2 years

N/A—Not applicable: The product does not have this feature.

way P5-60 Family PC; it will come with certain NEC systems by March 1995. Performance lagged behind other quad-speed drives we've seen. If you need a quadruple-speed drive to handle playback of demanding AVI files, you should look elsewhere.



Mitsumi FX400, Mitsumi FXN01DE

We pulled the drives from the systems and installed them in our test-bed, to make sure all test numbers were comparable. The FXN01DE has an average-rated access time of 318 ms and throughput of 307 KBps. The caddyless unit normally has a motorized tray, a headphone jack, and volume control—but IBM has chosen to do away with the last two niceties. The FXN01DE performed on a par with other double-speed units on our tests. One notable exception was on our CorelDRAW installation test, where its time of 5 minutes 12 seconds lagged behind other ATAPI IDE drives. On the multimedia playback tests, it dropped more video frames than most other Enhanced IDE drives.

As we went to press, the FX400 from our Gateway 2000 system was arriving in retail channels under the Mitsumi banner. On our CorelDRAW installation test, the FX400 completed the process in 4 minutes 45 seconds—near the bottom of the pack of quad-speed drives. Its showing on our application launch and application search tests placed it in the middle of the pack. The drive had no problem handling playback of basic AVI files. But when it came to our killer custom AVI file, playback was jerky at best. It dropped 457 out of a possible 599 frames.

All things considered, our impression is that you can do better than the drives these systems deliver.

▶ **Mitsumi FX400.** List price: *$299; upgrade from double-speed, $100 (for Gateway customers).* Gateway 2000 Inc., *P.O. Box 2000, North Sioux City, SD 57049-2000; 800-846-2000, 605-232-2000; fax, 605-232-2023.* **Mitsumi FXN01DE.** List price: *$199 (for IBM customers).* IBM Personal Computer Co., *Rte. 100, Somers, NY 10589; 800-772-2227; fax, 800-426-4329.*

Circle 457(Gateway), 504(IBM) on reader service card

Goldstar USA Inc.

• Goldstar GCD-R320B

BY STEVEN C. M. CHEN

The double-speed Goldstar GCD-R320B, at $239.95, is the lowest-priced SCSI drive in this roundup. Adequate

SUMMARY OF FEATURES

ENDS

Products listed in review order ■ = YES □ = NO	Philips CDD300	Pioneer DRM-604X	Plextor 4PLeX PX-43CH	Sony CDU-55E	Sony CDU-55S	Toshiba XM-3501	Toshiba XM-4100A
List price or estimated street price:							
Internal drive	$299.00 (list)	N/A	$469.00 (list)	$199.95 (list)	$249.95 (list)	$400.00 (list)	N/A
External drive	N/A	$995.00 (list)	$549.00 (list)	N/A	$329.95 (list)	$545.00 (list)	$360.00 (list)
Interface card	■	Optional	Optional	Optional	Optional	Optional	Optional
General Features							
Speed	2x	4x	4x	2x	2.4x	4x	2x
Data transfer rate (kilobytes per second)	307	614	800	300	360	600	300
Buffer size	256K	128K	1MB	256K	256K	256K	64K
Average access time (milliseconds)	290	300	220	250	220	120	320
Types of connections	ATAPI IDE	SCSI	SCSI	ATAPI IDE	SCSI	SCSI	SCSI, SCSI/parallel (optional)
Mechanism manufacturer	Philips	Pioneer	Plextor	Sony	Sony	Toshiba	Toshiba
Mechanism model	CDM12.4	DRM-604X	PX-43CH	CDU-55E	CDU-55S	XM-3501	XM-4100
Dimensions of external version (HWD, in inches)	N/A	4.1 x 8.3 x 14.6	7 x 2.4 x 12	N/A	2 x 7 x 12.9	2.7 x 8.7 x 9.8	1.3 x 5.5 x 8.3
Weight of external version (pounds)	N/A	9.1	6.2	N/A	5.3	4.3	1.2
Requires caddies	□	■	■	□	□	■	□
Power indicator/Busy indicator	□■	■■	■■	■■	■■	■■	■■
Manual eject/Software eject	■■	■■	■■	■■	■■	■■	■□
Headphone jack/Volume knob	■■	■■	■■	■■	■■	■■	■■
RCA jacks/Red Book audio connector	N/A■	■N/A	■■	N/A■	■□	■■	■N/A
Customer Support							
Toll-free technical support	■	■	■	□	□	□	□
Telephone support hours (eastern time)	24 hours, 7 days	9:00–7:00 M–F	11:30–8:30 M–F	12:00–8:00 M–F	12:00–8:00 M–F	11:00–3:00, 4:00–7:00 M–F	11:00–3:00, 4:00–7:00 M–F
24-hour BBS	■	■	■	■	■	■	■
Warranty coverage	2 years	1 year	2 years	1 year	1 year	1 year	1 year

N/A—Not applicable. The product does not have this feature.

performance for such a bargain price may tempt you to overlook the drive's paltry 64K buffer and quirks, but we recommend waiting for Goldstar's forthcoming quad-speed unit, the GCD-R540B ($250), which was not shipping in time for this review.

Goldstar GCD-R320B

The MPC Level II-compliant drive features a 250-ms average access time and 300-KBps transfer rate. On our tests, the Goldstar provided some highlights as well as lowlights. It was among the best of the double-speed drives on our Intel Indeo multimedia playback test (dropping just three frames), but more demanding video playback showed the drive's weaknesses. Videos weren't as smooth as on other drives, and the dropped frames were much more noticeable. Also, it took the Goldstar a lengthy 5 minutes 12 seconds to complete our CorelDRAW installation test, longer than with other SCSI units.

Installing the internal drive is straightforward, and if you don't like lengthy manuals you'll love the Goldstar: An oversized foldout sheet covers all the necessities. One oddity, though, is the unit's nonmotorized tray. The caddyless drawer ejects only about halfway; you have to pull the tray out the rest of the way and push it in manually. Goldstar does provide a software utility to play audio CDs.

▶ **Goldstar GCD-R320B.** List price: *$239.95.* Goldstar USA Inc., *1000 Sylvan Ave., Englewood Cliffs, NJ 07632; 201-816-2000; fax, 201-816-2188.*

Circle 458 on reader service card

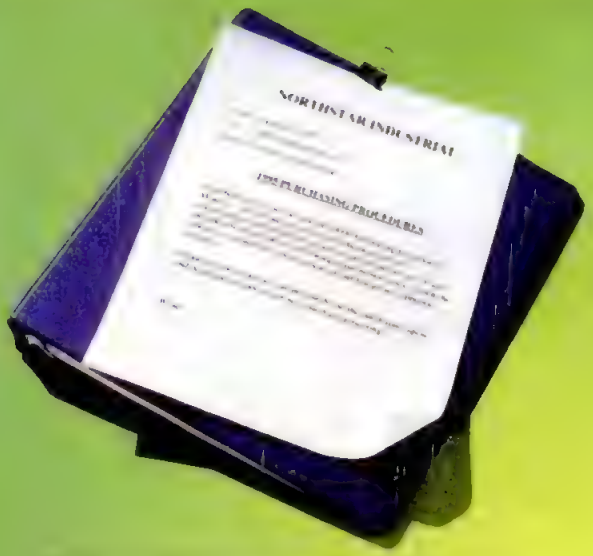
Liberty Systems Inc.

• Liberty 115CDT4xP

BY STEVEN C. M. CHEN

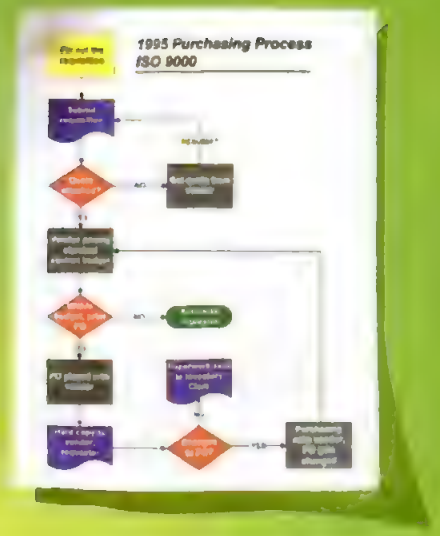
In case you're looking for a quad-speed CD-ROM drive designed for both desktop functionality and transportability—and you're not averse to paying for the convenience—take a look at Liberty 115CDT4xP. The $699 base price gets you the drive with both parallel and SCSI connectors, and Liberty will sell you a 16-bit Future Domain TMC-1670 SCSI-2 controller for $129 more. The company has built in some of the items that you have to pay extra for with truly portable devices, and the drive performed admirably, especially on our multimedia test suite.

One advantage of the Liberty is that you don't need an external SCSI-to-parallel convertor. The unit has one built-in, which accounts for its oversize profile of 1.9 by 6.8 by 9 inches. A fan, audio



(Sort through a fifty page plan to get to the point.)

or



(Get to the point with a single Visio diagram.)

AND NOW A FEW WORDS ON WHY WORDS ALONE ARE NOT THE MOST EFFECTIVE WAY TO CONDUCT DAY TO DAY BUSINESS.

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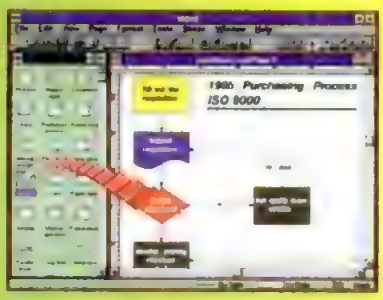

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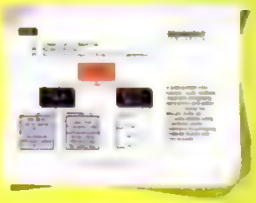

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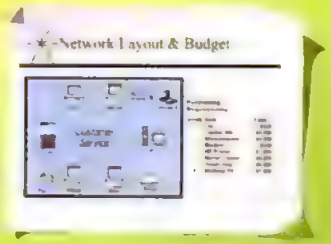

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CIRCLE 006 ON READER SERVICE CARD

connectors, and a pass-through parallel port are also standard, and the case has a power supply built-in; there is no battery option for on-the-road operation. Packed with all these components, not surprisingly the Liberty weighs in at slightly over 4 pounds—much heavier than traditional portables. Liberty also bundles two software utilities with the unit: PowerSCSI! for connection to the SCSI controller and ShuttleManager for connecting through the parallel port.

Setting up the drive can be slightly involved, since the unit can be used as either a SCSI or parallel CD-ROM drive. The

Liberty 115CDT4xP

manual is not as helpful as it could be: We found ourselves wishing for more full-size illustrations with clearer details. You can also connect additional SCSI devices through the Liberty drive's SCSI port, as long as you attach the Liberty to your PC via the parallel port.

Performance using the SCSI controller is one of the drive's strongpoints. Throughput was the best we saw. It was also the best quad-speed performer on our Intel Indeo compression test, and among the best on the other multimedia tests, assuring smooth video playback. Expect performance through the parallel port to degrade, however, due to the slow throughput of the parallel bus.

The everything-but-the-kitchen-sink approach has advantages for those who want SCSI performance at some times and transportable convenience at others, and performance from the Liberty 115CDT4xP should satisfy.

▶ **Liberty 115CDT4xP.** List price: *$699 (without parallel port, $599); SCSI controller, $129; carrying case, $29.* Liberty Systems Inc., *375A Saratoga Ave., #A, San Jose, CA 95129-1339; 408-983-1127; fax, 408-243-2885.*

Circle 459 on reader service card

Media Vision Inc.

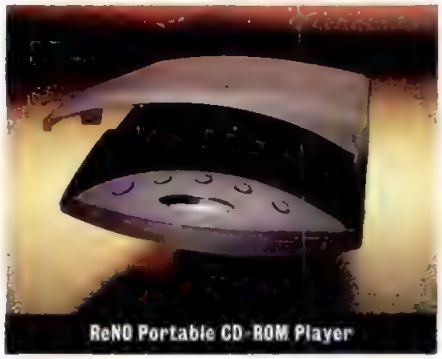
• ReNO Portable CD-ROM Player

BY JACQUELINE EMIGH

The ReNO Portable CD-ROM Player, list-priced at $349—less than most other double-speed external CD-ROM drives—is a dual-duty drive worth considering. Beyond its role as a standard CD-ROM drive, Media Vision's ergonomically elegant ReNO also serves as a portable audio CD player. Video performance was a little behind most other SCSI units we tested, but the portable convenience may be worth the hit.

Weighing in at 1.2 pounds and measuring a mere 1 by 6.3 by 10.3 inches, the sleek ReNO is well suited to life on the road. The drive's nonmotorized caddyless tray slides in and out with little effort. For cordless operation on the road, the unit uses four standard alkaline batteries. You'll have to supply a SCSI-to-parallel cable or a PCMCIA SCSI adapter to connect it to your laptop; Media Vision plans to offer one as an option, though no price had been determined at press time.

We tested the drive using a SCSI card from Adaptec. On several of the tests—CD-ROM throughput, application search, and CorelDRAW installation — the ReNO performed outstandingly well, ahead of most of the other double-speed drives we evaluated. Performance was less laudable on our multimedia playback tests, though. On our Video 1 compression and Intel Indeo video compression tests, for example, the ReNO dropped more video frames than most other SCSI double-speed drives. This resulted in video playback that was a little choppier than we saw with other drives.



ReNO Portable CD-ROM Player

Media Vision also bundles the ReNO in its Premium Deluxe Multimedia Kit, which delivers the drive, a 16-bit 3-D sound card with SCSI-2 interface, speakers, and other goodies (including a how-to installation video and 18 CD titles) for $599. If portability appeals to you, and you often want both a CD-ROM and an audio CD player on the road, the ReNO is an elegant and affordable solution.

▶ **ReNO Portable CD-ROM Player.** List price: *$349.* Media Vision Inc., *4255 Burton Dr., Santa Clara, CA 95054; 800-348-7116; 510-770-8600; fax, 510-770-8648.*

Circle 460 on reader service card

Mountain Network Solutions Inc.

• Mountain CD7

BY STEVEN C. M. CHEN

If you find yourself changing CD-ROM disks regularly, Mountain Network Solutions has a solution. With the Nakamichi-built Mountain CD7 disk changer, you have ready access to up to seven disks. This double-speed SCSI component wasn't an impressive performer, but at $649 list ($499 street), it's one of the least-expensive multidisk players around.

Measuring in at 3.7 by 7.8 by 12.6 inches, this external drive is slightly taller than a standard external drive. It holds seven disks internally, as opposed to the Pioneer DRM-604X (also reviewed here), which holds six disks in a pop-out cartridge. Mountain doesn't offer a SCSI controller option with the CD7; we had to use our Adaptec AHA-1542CF controller instead. Setting up the CD7 is straightforward, though the software installation required a few extra steps. We first installed the necessary device driver for the Adaptec controller, then installed the software for CD7, which created a conflict between two sets of drivers. To resolve the problem, we had to change the CONFIG.SYS and the AUTOEXEC.BAT files manually. Mountain tech support claimed that the drive usually has no conflicts with Adaptec controllers, and that in fact some Mountain products ship with them. The CD7 does require a lot of system memory. MSCDEX reserves separate buffers for each drive, and in this case, each of the seven disks is treated as a different drive. As a result, MSCDEX took up 73K, which is about 40K more

than other drives.

Loading and unloading disks is as simple as pressing a button (one for each slot). Mountain includes thoughtful extras, such as a software utility that displays the titles of the disks that are loaded and indicates which are audio CDs. Performance from the CD7 was slow for a SCSI unit; it posted the second-slowest throughput score of any nonparallel drive, and was slower than average on our application launch and application search tests. It placed in the middle of the pack on our CorelDRAW installation test (with a time of 5 minutes 8 seconds), but it dropped more video frames on our multimedia playback tests than other SCSIs.

Mountain CD7

Still, the Mountain CD7 fills a niche. For those who need a multidisk changer but don't want to spend almost a thousand dollars, this unit is a fine choice.

▶ **Mountain CD7.** List price: *$649.* Mountain Network Solutions Inc. (subsidiary of Nakamichi Peripherals Corp.), *360 El Pueblo Rd., Scotts Valley, CA 95066-4268; 800-458-0300, 408-438-6650; fax, 408-461-3047.*

Circle 461 on reader service card

Dell Computer Corp.

• NEC MultiSpin CDR-260R

NEC Technologies Inc.

• NEC MultiSpin 3Xp Plus
• NEC MultiSpin 4Xi

BY TED NEEDLEMAN

We looked at a range of CD-ROM drives from NEC. The SCSI-2–compatible NEC MultiSpin 4Xi bundle ($495 street) is an internal quadruple-speed drive that showed good video-handling performance on our tests. The NEC MultiSpin 3Xp Plus ($495 street), another SCSI-2 drive, is a 4.6-pound portable unit that can be operated from an optional battery pack or from the included AC brick. We also looked at the NEC CDR-260R, a double-speed Enhanced IDE–interface drive that at the present time is available only in machines from Dell.

The two SCSI MultiSpin drives each include a Trantor T-160 16-bit SCSI card, appropriate cables, a disk caddy, a 256K buffer, an interactive tutorial CD, and Microsoft's Encarta. Both drives are available without the interface card and Encarta for about $80 less. There's also some very-to-the-point documentation and a small installation poster that take you through the quick process of getting up and running. The MultiSpin 4Xi ships with the required disk caddy.

Installing the two units was a breeze. We used the defaults on the SCSI host adapter, and launched NEC's "Simple Start" install program from Windows. A second disk contains the DOS version of the install program, in case you are not a Windows user. This program installed the proper drivers and placed a "music box" program (which lets you play audio CDs through the drive) in the SCSI directory. Each SCSI drive has a front-mounted, backlit LCD panel that shows the status of the drive. Additionally, the drives can sense whether the disk in the drive is an audio CD or CD-ROM; they then adjust the motor speed accordingly and route the signal to the appropriate output.

The MultiSpin 4Xi has a dust door that automatically ejects the caddy when you pull the door down. Performance results were generally very good. It handled our video files with aplomb, ranking among the best quad-speed drives. It also showed good throughput scores and was one of the quickest on our CorelDRAW installation test. It lagged behind the quad-speed field slightly on our application launch and application search tests, however.

The 3Xp Plus, which is actually a "3.3-speed," was also no slouch. On the video performance tests, in fact, it even bested some quad-speed units. Especially for a portable drive, it was clearly a speed demon. It's important to realize, however, that the 3Xp Plus's results were achieved with the Trantor 160 internal 16-bit SCSI interface that the vendor provided. It's very possible that a different card would have resulted in different numbers. Keep in mind, also, that using it with a parallel-to-SCSI cable would obliterate the performance advantages. For portable use, a high-performance PCMCIA SCSI interface is clearly the way to go.

The OEM-only CDR-260R, which we took out of a Dell Dimension 466, was somewhat less impressive on several of the tests. While it achieved decent throughput for a double-speed unit, its results on the CorelDRAW installation test were disappointing. It also handled our video playback tests poorly overall. But keep in mind that this drive—even for the OEM market—is priced to compete ($125).

On the retail side, both the MultiSpin 4Xi and the 3Xp Plus deliver high quality with good performance. The MultiSpin 4Xi is a good choice for demanding video applications, while the 3Xp Plus delivers a good balance of performance, price, and utility.

▶ **NEC MultiSpin CDR-260R.** List price: *$125 (for Dell customers).* Dell Computer Corp., *2214 W. Baker Ln., Austin, TX 78758; 800-613-3355, 512-338-4400; fax, 800-727-8320.* **NEC MultiSpin 3Xp Plus.** Estimated street price: *$495.* **NEC MultiSpin 4Xi.** List price: *$495.* NEC Technologies Inc., *1414 Massachusetts Ave., Boxborough, MA 01719-2298; 800-632-4636, 508-264-8000; fax, 508-264-8831.*

Circle 462 on reader service card

NEC MultiSpin CDR-260R, NEC MultiSpin 3Xp Plus, NEC MultiSpin 4Xi

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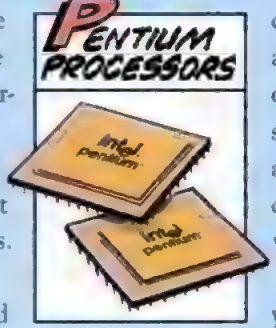

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CIRCLE 215 ON READER SERVICE CARD

Panasonic Communications & Systems Co.

• Panasonic LK-MC509S
• Panasonic LK-MC579BP

BY TED NEEDLEMAN

Panasonic submitted two drives that nicely cover both ends of the double-speed spectrum. The $399 Panasonic LK-MC509S is an affordable external drive with a SCSI interface. It turned in good test results, most notably on the video playback suite. The second drive, the $249 LK-MC579BP, was among the quickest double-speed units on our application tests, and also represents a good value. This internal LK-MC579BP uses the new, enhanced IDE interface with ATAPI support. And interestingly, the caddyless unit has a unique platter tray that lets you mount and use the drive vertically.

Installation of the SCSI drive presented no problems, though we did have to supply our own interface card (we used an Adaptec AHA-1542CF). Adaptec's EZ-SCSI software does not automatically install in high memory, nor do the drivers that Panasonic provides.

Panasonic LK-579BP, Panasonic LK-MC509S

Most users should have no trouble setting up the IDE-based LK-MC579BP. But we did run into a hitch with the secondary channel of our IBM test-bed's motherboard. We managed to get the drive up and running by daisy-chaining it on the hard disk cable. That's not an ideal situation for real-world use, but for our tests it did not seem to present any performance handicap. The drive also ships with an IDE interface card. The drive comes with EZ installer software that lives up to its name, though it does not offer the option to install the drivers in high memory to save RAM. The LK-MC579BP also comes with an audio cable to connect with your sound card. The cable sports three different connectors on the sound-card side, so you can easily plug into just about any card on the market. A thoughtful touch.

Both drives performed fairly well on our tests. Throughput results and times on the application launch and application search tests placed the LK-MC509S in the middle of the double-speed SCSI pack, and it was the quickest double-speed at loading CorelDRAW from the platter (4 minutes 40 seconds). It was among the best on our video playback tests, generally dropping fewer frames than the average double-speed. The Enhanced IDE LK-MC579BP turned in one of the quickest times among the double-speeds on our application launch and application search tests; performance on our video playback suite was also good.

Panasonic's parent company, Matsushita, is a popular OEM supplier of drives, and these two are worth consideration if you're in the market for a double-speed unit. You won't be disappointed with the performance, and both offer nice touches that make them worth the small premium over bargain-priced units.

▶ **Panasonic LK-MC509S.** List price: *$399.* **Panasonic LK-MC579BP.** List price: *$249.* Panasonic Communications & Systems Co., *2 Panasonic Way, Secaucus, NJ 07094-9844; 800-742-8086, 201-348-7000; fax, 201-392-4441.*

Circle 463 on reader service card

Philips LMS

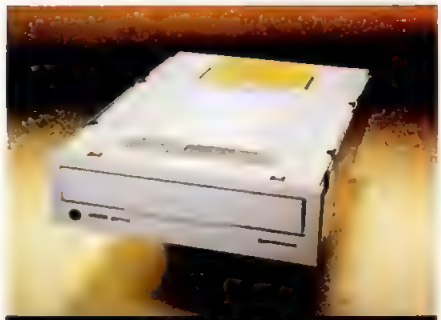
EDITORS' CHOICE

Philips CDD300

BY STEVEN C. M. CHEN

Turning away from its earlier proprietary designs, Philips now offers a double-speed drive with an industry-standard Enhanced IDE/ATAPI interface. Moreover, the Philips CDD300 model we tested turned in some of the best double-speed results on both our application tests and our video playback suite. With a list price of just $299 ($199 street), the Philips gets an Editors' Choice.

Most users will be able to pop this internal unit into a system and have it work without a hitch. But we did run into problems with Philips' IDE cable. The cable is keyed to prevent it from being installed incorrectly, but our system required a nonkeyed IDE cable. Philips says a fix is in the works. In case your system doesn't have a spare IDE channel (or if your channel is incompatible), Philips includes a 16-bit IDE controller at no extra charge.



Philips CDD300

The real news here, though, is the speed. The Philips showed good throughput for a double-speed drive. Its time on our CorelDRAW installation test (4 minutes 54 seconds) was better than most double-speeds. Perhaps more important, it gave an impressive performance on our multimedia playback suite with some results besting several quad-speed units. The Philips was among those that dropped the fewest video frames on our Video 1 compression, Intel Indeo compression, and custom AVI file tests; among the double-speeds, it was bested only by a SCSI unit (the Goldstar GCD-R320B). Indeed, multimedia playback was noticeably smoother than with other double-speed drives.

With admirable performance, a good price, and newfound compatibility, it's tough to find fault with the Philips CDD300.

▶ **Philips CDD300.** List price: *$299 (includes 16-bit IDE controller).* Philips LMS, *4425 Arrowswest Dr., Colorado Springs, CO 80907-3489; 800-777-5674, 719-593-7900; fax, 719-599-8713.*

Circle 464 on reader service card

Pioneer New Media Technologies Inc.

• Pioneer DRM-604X

BY JONATHAN HILL

Pioneer's quad-speed DRM-604X CD-ROM changer ($995 list) is an external, six-CD jukebox that received an Editors' Choice in last year's roundup (February

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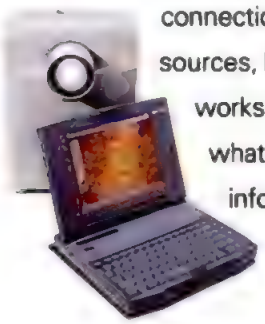

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CIRCLE 217 ON READER SERVICE CARD

22, 1994). Other quad-speed drives have surpassed the DRM-604X in overall performance, but this drive is still a worthy choice for quad-speed performance and multidisk convenience.

The DRM-604X lets you load up to 6 CD-ROMs into a special caddy. Pioneer's driver software reserves a separate drive letter for each slot, so selecting a drive letter initiates a mechanical switching process that is roughly analogous to that of a traditional jukebox. There is a slight delay (5 seconds or so) while the mechanical arms change the disks, but if you spend a lot of time swapping the same CD-ROM titles in and out of a single-disk unit, the DRM-604X was made for you. Pioneer offers the same setup in a double-speed, the DRM-602X ($495)—not to mention a quad-speed 18-disk changer, the DRM-1804X ($2,495), for the seriously addicted.

Installation of the SCSI unit was fairly straightforward. Pioneer's software comes with presets for working with ASPI-compliant SCSI drivers, or for working more directly with SCSI controllers from Future Domain or IBM or Pioneer's own DD-c5002 cards. We paired the DRM-604X with an Adaptec AHA-1542CF controller, ran Adaptec's EZ-SCSI installation software to install the proper ASPI drivers, and then installed Pioneer's jukebox driver to activate the six drive letters.

In last year's roundup, the DRM-604X was the unquestioned performance leader. This time, however, other quad-speed units bested the DRM-604X, especially on our application launch and application search tests. Still, the drive achieved high sustained throughput and was among the fastest units on our multimedia playback tests. If full-motion video and sound are are on your agenda, the DRM-604X can handle it.

Pioneer DRM-604X

The surprisingly compact DRM-604X (4.1 by 8.3 by 14.6 inches) was a breakthrough product when introduced over a year ago. Advances in competitors' offerings have eroded some of the unit's luster, but the DRM-604X is still a contender.

Plextor 4PleX PX-43CH

▶ **Pioneer DRM-604X.** List price: *$995; 8-bit SCSI controller, $100; 16-bit SCSI controller, $200; Microchannel SCSI controller, $300.* Pioneer New Media Technologies Inc., *2265 E. 220th St., Long Beach, CA 90810; 800-444-6784, 310-952-2111; fax 310-952-2990.*

Circle 465 on reader service card

Plextor

• Plextor 4PleX PX-43CH

BY JACQUELINE EMIGH

Plextor's 4PleX PX-43CH is a good example of how CD-ROM drives with solid multimedia playback are getting more affordable. Not long ago, serious connoisseurs of CD-ROM paid upwards of $1,000 for the 600-KBps data-transfer rate of the quad-speed drive. Now you can buy the Plextor bundle for about half that price ($499 list and street), gaining a 1MB buffer in the bargain, along with a Future Domain 16-bit SCSI-2 adapter. A standalone edition of the same drive lists for $459. In case you prefer an external drive, Plextor offers a bundle that includes an external quad-speed drive, a caddy, and an Adaptec AHA-1515 adapter for $599; the external drive alone is $549. For more budget-conscious buyers, the company also offers quad-speed drives with 256K buffers: the PX-43CS-256 Internal Quad Kit ($429) and the PX-43CS ($359).

The kit comes with clear documentation on both the internal drive and Future Domain adapter, easing the hardware configuration process a lot. The PowerSCSI! software is simple to use—in fact, it's self-explanatory.We had it up and running in minutes. The drive also furnishes conveniences such as a headphone jack and software eject. It has a motorized eject but not autoload; you must push in the drawer manually after loading a disk.

The Plextor provided a somewhat mixed performance picture on our tests. Video playback was generally excellent: The Plextor dropped fewer frames under 16-bit Video 1 compression than any of the other drives evaluated, while exhibiting the lowest CPU utilization. But it made a poor showing with our more difficult custom AVI file: The Plextor dropped more video frames here than other quad-speeds (save the Computer Connections CD Shuttle PSM, which was tested through the parallel port). Apparently, the Plextor had difficulty with the particular CD-R disk we created in-house (though the other quad-speeds had no such difficulty). It performed better—about average among quad-speeds—on the production disk we later obtained. Throughput figures and times on our application launch, application search, and CorelDRAW installation tests were also at or near the bottom of the quad-speed pack.

Still, the Plextor should be more than adequate for most multimedia chores. If you're thinking quad-speed, consider the Plextor.

▶ **Plextor 4PleX PX-43CH.** List price: *$499.* Plextor, *4255 Burton Dr., Santa Clara, CA 95054; 800-475-3986, 408-980-1838; fax, 408-986-1010.*

Circle 466 on reader service card

Sony Electronics Inc.

• Sony CDU-55E

EDITORS' CHOICE

Sony CDU-55S

BY TED NEEDLEMAN

In the push to gain a bit of an edge in the fiercely competitive CD-ROM market, Sony Electronics has rolled out a unique double-speed-and-then-some drive, the Sony CDU-55S. This "2.4-speed" SCSI drive delivers impressive performance—it surpassed some quadruple-speed SCSI drives on our tests—at a price competitive with standard double-speed units. The internal version (which we tested) lists for

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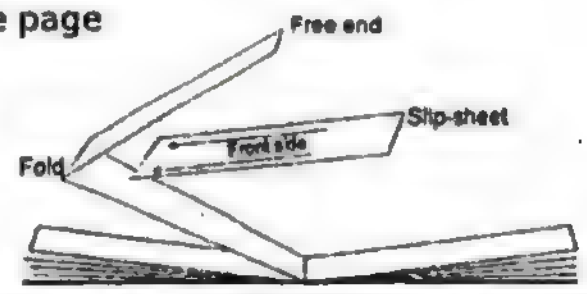

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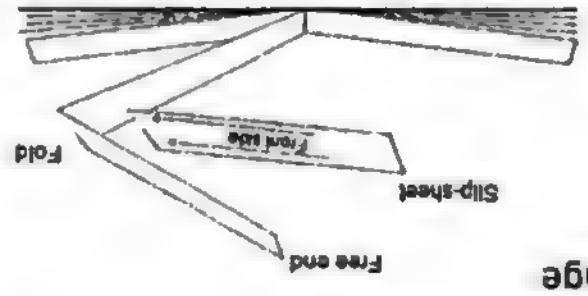

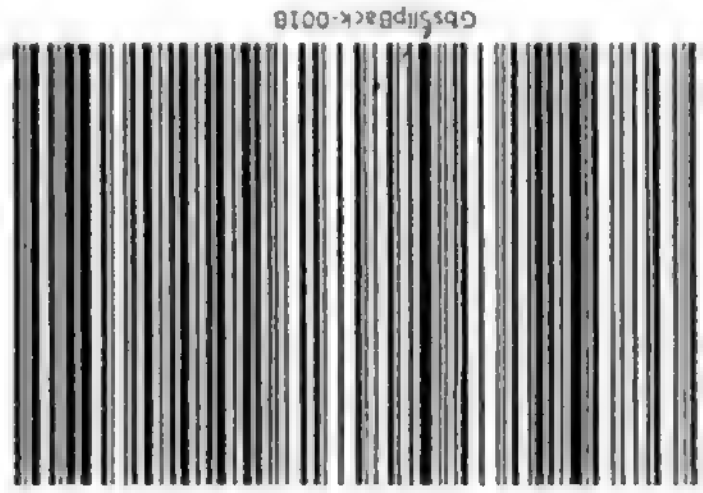

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intel inside

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Sony CDU-55E, Sony CDU-55S

$249.95; an external version is available for $80 more. We also looked at the Sony CDU-55E, a traditional double-speed internal drive with an Enhanced IDE interface. This drive has been shipping to secondary vendors, and will now be available to end users for a suggested list price of $199.95.

Installing the units posed no problems. Sony offers an Adaptec AHA-1515 SCSI card as an option for the CDU-55S, which we used for testing. All told, we were up and running with both drives within minutes. If your PC does not sport a second IDE channel connector on the motherboard, you can use Sony's Future Domain IDE-16003 IDE paddleboard interface ($39.95).

Like other drives, both Sonys are caddyless units and have a volume-control knob on the front panel. Less usual is the emergency-eject port on the front panel. If your PC goes dead, or if the electronic eject fails to operate, you can retrieve your CD-ROM from the tray by sticking a straightened paper clip into the eject port. We've been caught in this spot a few times in the past, so we appreciate this thoughtful feature.

In terms of performance, Sony's use of a 2.4-speed pays off. As you might expect, throughput was approximately 20 percent higher than for an average double-speed unit. What you might not expect is how that translated on our tests: The CDU-55S outperformed some pricier quad-speed units on our application launch and CorelDRAW installation tests. It beat the *majority* of quad-speed drives on the application search test. Video and audio playback on our multimedia test suite was similarly excellent. The CDU-55S proved itself to be good enough for video-intensive multimedia applications.

The double-speed CDU-55E was not such a standout. It showed average throughput, but was among the slowest of the double-speeds on application search and CorelDRAW installation tests. Multimedia playback was respectable, and the CDU-55E dropped fewer frames than many of its competitors.

The CDU-55S offers excellent performance at a reasonable price. The CDU-55E is competent, but we suggest you spend the extra $50 for the CDU-55S.

▶ **Sony CDU-55E.** List price: *$199.95.* **Sony CDU-55S.** List price: *$249.95.* Sony Electronics Inc., *3300 Zanker Rd., San Jose, CA 95134; 800-352-7669, 408-432-1600; fax, 408-943-0740.*

Circle 467 on reader service card

Toshiba America Information Systems Inc.

EDITORS' CHOICE

Toshiba XM-3501
• Toshiba XM-4100A

BY STEVEN C. M. CHEN

If you're looking for a top-of-the-line quad-speed drive, then the Toshiba XM-3501 is one to take a very close look at. It was at or near the front of the pack in our multimedia playback tests. This quad-speed internal drive lists for $400 (without the SCSI controller). An external version, the XM-3501E, lists for $545, sans adapter. If portability is more a concern than blistering performance is, the $360 (without adapter) double-speed Toshiba XM-4100A offers a lightweight option.

Toshiba XM-3501, Toshiba XM-4100A

Without question, Toshiba's quad-speed mechanism is one of the most popular. Out of ten quad-speed drives in this roundup, half incorporate a version of the Toshiba drive. Performance from the XM-3501 was just average among quad-speeds on our application launch and application search tests, but its time of 3 minutes 49 seconds on the CorelDRAW installation run was the fastest we saw. Multimedia playback, though, is where this drive really shines. It was near the top of all contenders on the Video 1 compression and Intel Indeo compression playback tests. It bested all other drives in handling our killer custom AVI file, dropping the fewest video frames while showing the lowest CPU utilization. If video-intensive multimedia is in your future, the XM-3501 should provide jitter-free playback.

The portable XM-4100A is light, weighing just 1.2 pounds (not including the $42 AC brick). It has a low profile, measures 1.3 by 5.5 by 8.3 inches, and comes standard with a full-size 50-pin SCSI connector and headphone jack for audio output. The clamshell design of the XM-4100A also sports a window that gives you a view of the disk you have loaded, a nice extra. If a SCSI port is not available on your PC, Toshiba offers a parallel-port kit ($180). We tested the XM-4100A with the $175 16-bit Future Domain TMC-1650EX SCSI-2 adapter. Its performance characteristics did not stand out, but it holds its own as a portable unit. It placed right in the middle of the SCSI double-speed pack on our application tests. Its multimedia playback results, while respectable for a portable, were a touch below par among double-speeds on the whole. The unit would be a poor choice for demanding video playback.

If you need the convenience of a portable, however, the Toshiba XM-4100A is a better choice than many others. If you need uncompromising video playback from a quad-speed drive, look no further than the Toshiba XM-3501. □

▶ **Toshiba XM-3501.** List price: *$400; 8-bit interface, $155; 16-bit interface, $175.* **Toshiba XM-4100A.** List price: *$360; interface, $155.* Toshiba America Information Systems Inc., *9740 Irvine Blvd., Irvine, CA 92718; 800-334-3445, 714-583-3000; fax, 714-583-3645.*

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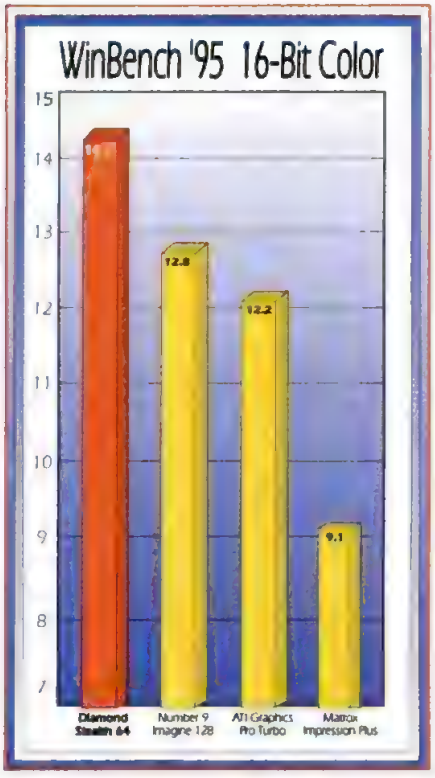

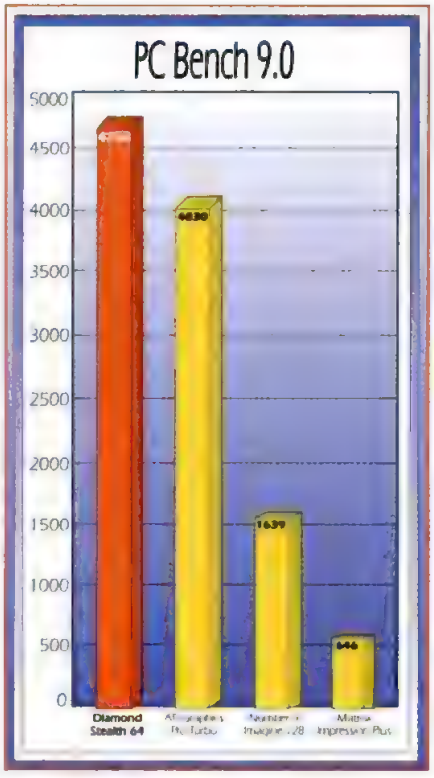

Windows 3.1 PCI performance tests performed by Diamond Multimedia Systems, Inc. on publicly available hardware and software running Ziff-Davis' WinBench® 95 Version 1.0 on an HP Vectra XU 5/90 Pentium 90MHz system with 256k cache, 40MB RAM, 540MB SCSI hard disk, SmartDrive 2048 128, and DOS 6.2. All Cards were tested at 1024x768x65k 72Hz Large Font. The Stealth 64 VRAM was configured with 2MB of VRAM using driver release 1.20. The ATI Graphics Pro Turbo was configured with 2MB VRAM using driver release v1.03. The #9 Imagine 128 card was configured with 4MB VRAM using driver release v1.29. The Matrox Impression Plus was configured with 2MB VRAM using driver release 1.42.

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CIRCLE 176 ON READER SERVICE CARD

AN EARFUL OF SOUND BOARDS

To join in the multimedia revolution, you need a PC that can talk and sing. Sound boards now offer better sound quality and fewer installation headaches than ever before.

By John R. Quain

If you're looking to add sound capabilities to your system now, the good news is that sound boards have improved in both sound quality and ease of installation. The bad news is that even though setup has gotten easier, sound cards remain the most difficult kind of peripheral to install in your PC.

Nevertheless, millions of computer users are adding sound boards to their existing PCs to take advantage of multimedia CD-ROMs and business applications with multimedia help. System vendors are increasingly shipping PCs with sound boards already installed. Accord-

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ing to Dataquest, a market research firm based in San Jose, California, sound board shipments nearly doubled from 1993 to 1994, with over 11 million boards expected to ship in 1995. And although sales of separate sound boards are expected to outnumber sales of sound-enabled PCs by a margin of about 3 to 2 in 1995, that trend is expected to reverse by next year as more and more vendors ship multimedia-ready PCs.

REVIEW CRITERIA

For this roundup, we focused on sound boards meeting the Multimedia PC Marketing Council's MPC Level 2 specification. That means that all the boards had to record and play back 16-bit, 44.1-kHz stereo sound as well as digital audio .WAV and MIDI (Musical Instrument Digital Interface) files. The *44.1-kHz* means that the sound card takes 44,100 samples per second; *16-bit* refers to the size of each sample.

In all, ZD Labs subjected 29 sound cards from 21 vendors to rigorous audio tests, tortuous installation trials, and hands-on evaluation. Of the boards, 26 are reviewed in the main feature, while 3 combination sound/telephony cards are examined in the sidebar "Voice Mail for All." All boards had to be shipping in quantity by mid-November, 1994.

Several sound board products were not received or were not shipping in time for our testing. They include ACS/KRIS Technologies' ACS LaserWave Basic 16; the Ad Lib MSC 16 Plus, Ad Lib MSC Wave Pro 16, and Ad Lib Systel, from Ad Lib Multimedia; Advanced Digital Systems' ADS Audio Rock-it Pro; the DSP Solutions Port-Able Sound Plus; Kalix's Kalix Sound Trax; Prolink Computer's Prolink Sound 16 Pro; Toptek Technology's Toptek GS-32 Wavetable PCM; and Triumph Logistic Computers' Triumphony Audio Forge Professional A-10.

We tested but then excluded from our roundup two offerings from TeleVideo MultiMedia (800-835-3228 ext. 474, 408-954-8333): the TeleVideo TeleSound Pro 16 ($129) and the TeleVideo TeleWave Audio 32 ($249). During our testing cycle, we received two iterations of the TeleSound Pro 16 with different chip sets. The first board performed exceptionally, the second unacceptably. A third TeleSound Pro 16, purchased on the open market by *PC Magazine*, had the same chip set as the second board we had received and also performed unacceptably. We could not buy comparison samples of the TeleWave Audio 32, since TeleVideo products are thinly distributed. Because TeleVideo officials couldn't clearly explain the performance discrepancies as of our deadline, we dropped the boards from our roundup.

Many boards boast CD-quality sound, but few actually managed to approach the high-fidelity sound of home CD players. Nevertheless, PC Magazine Labs' test results did turn up some sonic standouts in this group, notably the Editors' Choice Turtle Beach MultiSound Monterey and the Turtle Beach Tropez.

One notable complaint we had with most of the cards was that the built-in amplifiers continue to be a major weakness. Most models come with 4-watt-per-channel amplifiers, enough to assist self-powered speakers but not enough for

H I G H L I G H T S

16-Bit Sound Boards

With the explosive growth of multimedia software, sound and your PC now go together like love and marriage—and it has proven to be a stormy romance. The current generation of sound boards, though, smooths out some of those irreconcilable differences.

DO YOU NEED A PC that talks and sings rather than just beeps? A few years ago the answer was no. But new applications, from software with narrated tutorials to educational CD-ROM titles with audiovisual snippets, have made a capable sound board required.

BUSINESS AUDIO has been limited until recently to rudimentary voice command recognition and voice annotation utilities. But newer and more powerful telephony, videoconferencing, training, and groupware applications promise to make sound an indispensable part of the average business user's PC.

INSTALLING a sound board is still difficult, but many of the products we looked at this year have simplified the process by eliminating jumpers and instead offering software-selectable IRQs and DMA channels. Some products can even detect resource conflicts and help the user resolve them.

PLUG AND PLAY, an Intel/Microsoft specification that will be part of the upcoming Microsoft Windows 95, promises to make installing a sound board as simple as attaching a tape deck to a stereo system. None of the ISA boards we tested, however, were Plug and Play–ready. The New Media .WAVjammer is a Plug and Play–ready PCMCIA card.

MIDI SYNTHESIZERS, found on most sound boards, create music by manipulating instrument sounds stored in ROM or on your hard disk. FM synthesis, with its arcade-like sounds, is being replaced on midrange and high-end boards with more authentic wavetable synthesis, found on 18 of the products we tested.

SOUND QUALITY has improved significantly since last year. Just about all of the boards we tested are perfectly adequate for playing back the MIDI and digital .WAV files found in most edutainment titles. For more demanding multimedia authors, however, only two Turtle Beach entries offered true CD-quality sound for both recording and playback. The Antex Z1e came close.

TELEPHONY BOARDS combine sound and communications in one product, letting you add sophisticated voice mail and fax-back capabilities to your small business or home office. The first three entries we tested are impressive but still rough around the edges when it comes to performance and ease of use.

For authoring or high-end sound:

• Turtle Beach MultiSound Monterey

For business, edutainment, or games:

• Turtle Beach Tropez

As a group, the 29 16-bit sound boards we reviewed this year sound better and install with fewer hassles than the ones PC Magazine Labs reviewed a year ago.

And lower prices mean you're more likely to afford a board with the superior sounds generated by wavetable synthesis—actual sound samples—as opposed to FM synthesis.

Among high-end boards, Turtle Beach Systems once again earns an Editors' Choice, this year with the Turtle Beach MultiSound Monterey ($399 list, $329 street). This is the clear choice for no-compromise sound quality, with the best wavetable MIDI synthesizer and the most accurate digital recording and playback available. This audiophile's card still does not offer Sound Blaster compatibility, so gamers will need to look elsewhere (below is a good place to start). On the plus side, Turtle Beach has made installation much easier.

An honorable mention goes to the unique Antex Z1e ($595 list), from Antex Electronics Corp. The board has top-notch sound characteristics and MPEG audio compression, which lets multimedia authors compress files while still maintaining broadcast-quality audio.

Among lower-cost boards best suited for business, edutainment, and games users, an Editors' Choice goes to the midrange Turtle Beach Tropez, which combines Turtle Beach quality, Sound Blaster compatibility, a fine software bundle, and a fair price ($249 list, $229 street). Also in this class, and deserving an honorable mention, is the Creative Labs Sound Blaster AWE32 Value Edition ($329 list, $229 street). It delivers wavetable synthesis, good sound, and handy software utilities. Other boards are easier to set up, use less driver memory, and already support the future CD-ROM standard (IDE/ATAPI), but this Sound Blaster offering should still suit most users.

Five lower-cost boards merit honorable mention. For guaranteed Sound Blaster compatibility, it makes sense to go with the genuine article. The Creative Labs Sound Blaster 16 Value Edition delivers good though not spectacular sound at an affordable $99 (street).

The Reveal SoundFX has an unbeatable price ($69.99 list), and the Reveal SoundFX Wave is a sensational deal among wavetable-equipped boards ($160), marred only by mediocre channel separation and below-average Digital Recording test results. We also were impressed with the above-average performance of the Advanced Gravis UltraSound Max ($240, $170 street) and the Mediatrix Audiotrix Pro ($299, $225 street).

passive (nonamplified) speakers. Unfortunately, the built-in amplifiers without exception added noise to the sound boards' output (see "How We Tested").

To avoid this problem and deliver cleaner audio, most sound cards let you plug powered speakers into a low-level (nonamplified) line-out connector. Seven of the cards in this roundup do not include a built-in amplifier: Antex Electronics Corp.'s Antex Z1e, Best Data Products' Best Data ACE 5000, the Ensoniq Soundscape, the New Media .WAVjammer, Reveal Computer Products' Reveal SoundFX Wave, and the Turtle Beach Tropez and Turtle Beach Monterey.

On the positive side, our reviewers found that there was a general improvement in the quality of software bundled with these boards—although the dearth of such useful business applications as text-to-speech and voice recognition software is still an issue. The key software component for most is a mixer to adjust playback and record levels of the various sound sources, such as an audio CD player, a microphone, and the board's internal synthesizer. This year we felt the mixers had improved, offering greater flexibility and features like VU meters and record level controls.

SHOPPING FOR SOUND

Before choosing a sound board, there are several features to consider. Although all the boards here can handle MIDI recording for composing music, digital recording for storing sound clips, and analog audio playback from an audio CD, each has its own strengths and weaknesses.

For composition and multimedia work, pay particular attention to the sound card's MIDI features. MIDI files contain instructions for playing back synthesized musical instrument sounds stored in a sound card's ROM or RAM. An inexpensive method still employed by some cards is *FM synthesis*, which uses a combination of operators or sine waves (usually 4) to imitate the sounds of the different instruments. FM-synthesis sounds have an inauthentic arcadelike quality.

A superior and now more prevalent method is to use a *wavetable lookup synthesizer*. A wavetable contains actual prerecorded samples of instruments that can be manipulated by MIDI commands. Twenty of the boards we review use this approach. But not all wavetables are cre-

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ated equal. Depending on the amount of memory the card has to store instrument sounds, the quality of the samples, and the quality of the synthesizer itself, a wavetable synthesizer can sound like a kid's toy or a professional musician's tool. The best MIDI wavetables in this roundup are found on the Media Vision Premium 3-D and the Media Vision Pro 3-D, the Creative Labs Sound Blaster AWE32, and the Turtle Beach Monterey.

If you're not sure you'll ever care about MIDI work, you might hedge your bets by looking for a board that can be upgraded using a Wave Blaster–compatible daughterboard. Originally a wavetable daughtercard sold by Creative Labs for its Sound Blaster product line, the Wave Blaster is becoming a de facto standard.

Two additional special audio features made a significant showing this year. Nine of the boards reviewed here include or offer as an option so-called 3-D sound effects going under the rubric Sound Retrieval System (SRS) or Q-Sound. Both approaches are proprietary systems designed to improve the perceived stereo effect of speakers that sit only a few inches apart. Another technology, called the Spatializer, is so far found in the Multiwave Innovation AWS 32, which was not reviewed here.

These designs delay the timing of certain portions of the audio signal so that different frequencies hit your ear at slightly different times. The result can be a pleasing sense that the sound is coming at you from all around (as in a concert hall). Unfortunately, these effects sometimes add a noticeable amount of noise to the sound.

SPACE SAVINGS

For more conventional multimedia work, you can record voices, instruments, or sounds of any kind as digital .WAV files. The best-quality recordings are made using a 16-bit sampling size and a 44.1-kHz or better sampling rate, but the resulting .WAV files can be hard disk hogs. Just 60 seconds of Beethoven's Ninth Symphony recorded at this top sampling rate can consume nearly 11MB of disk space.

Unfortunately, the multitude of proposed compression standards has failed to dispose of the problem. Several vendors use ADPCM (Adaptive Differential Pulse Code Modulation) compression, but the sound quality is tinny, and there isn't a universally accepted ADPCM standard. That means what's recorded and compressed on one board may not play back on another. Only two boards in this feature, the Antex Z1e and the MediaMagic Telemetry-32 (covered in the sidebar "Voice Mail for All") offer MPEG compression and decompression, which boasts a file reduction of 12 to 1. The DSP Group has a compression/decompression algorithm (or codec) called TrueSpeech that is backed by Microsoft and intended for voice. To date, TrueSpeech is supported only by the Adaptec AudioEdge and the Adaptec SCSI AudioMachine, though Microsoft is expected to include it in Windows 95.

So the easiest way to keep sound clips from clogging your hard disk is to use lower sampling sizes and rates. All the cards in this roundup can store .WAV files at 8-bit, 11-kHz settings. At this low rate, a 60-second sample will be reduced from 11MB to about 600K.

Yet another issue that game players need to consider is Sound Blaster compatibility, most important for DOS-based games. Of the 29 boards in this feature, all but three claim Sound Blaster compatibility. Still, you may not see "Sound Blaster–compatible" written on all these boards in the store. That's because not all of the manufacturers have licensed the specification from Creative Labs, which has zealously defended its spec in court. Expect to see code words like "100 percent game compatible" on some cards to indicate that it will work with Sound Blaster–compatible games. On our tests, all the cards that claimed such compatibility worked with DOS games, but some sounded more like the actual Sound Blaster than others.

INSTALLATION HASSLES

Installing a sound board is such a notoriously laborious process that this year we decided to separate the truly easy installs from the worst; we did this by installing each board in a PC that already contained a network card and a SCSI adapter.

None of the ISA sound boards we looked at comply with the Intel/Microsoft Plug and Play specification, which should theoretically make sound card installation as easy as connecting a tape deck to your stereo receiver. We did look at a Plug and Play–ready PCMCIA card—the New Media .WAVjammer. Plug and Play is not expected to reach full fruition until Win-

Suitability to Task: 16-Bit Sound Boards

Some users just need a basic sound card for playing back the audio portions of games or other multimedia titles. Other users may need studio-quality sound reproduction so they can *create* the audio portions of multimedia titles. We rated the boards in this roundup on the following tasks so you can find the one that meets your needs.

Product Name	SUITABILITY TO TASK
MIDI composition	POOR
Business applications	FAIR
Multimedia authoring	GOOD
Games and edutainment	EXCELLENT

For serious **MIDI composition,** a board must provide superior digital and analog audio quality. Wavetable synthesis is important, and there should be at least 2MB (preferably 4MB) of wavetable ROM. Do all the instruments sound realistic? Wave Blaster compatibility is a plus, as is a software-upgradable sample set so you can add custom samples.

Boards that received a higher rating on our **business applications** task were easy to install, usually featuring setup software that diagnosed IRQ and DMA conflicts. The quality of voice recording and playback is important, and the board should offer a good compression scheme to let you embed documents with voice annotations without eating up lots of disk real estate. Finally, a good business bundle will provide a decent microphone and a host of useful applets, such as a text-to-speech program and a voice-command recognition program.

Products suited to **multimedia authoring** will provide an on-board DSP (digital signal processor) to process the audio signal and alleviate strain on your machine's CPU. Here, the quality of the recording—in addition to the playback—is tantamount.

We gave a lot of weight to ease of installation in our **games and edutainment** task. DOS memory utilization is important, since most games are DOS-based and may have trouble running if memory is misallocated. Sound Blaster and MPU-401 compatibility is requisite, as is a joystick port. The board should accommodate a range of different CD-ROM interfaces and boast lifelike audio playback.

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Performance Tests: 16-Bit Sound Boards

The sound boards that we tested this year have improved greatly over past years. Many now possess overall sound quality that was previously seen in only a few high-end boards, such as the Turtle Beach MultiSound.

What the Numbers Mean

We have categorized the 29 sound boards we reviewed into four groups, based on performance on our Preamplifier, Digital Playback, and Digital Recording tests. Results from the Power Amplifier tests were not used, since none of the boards possess an adequate amplifier circuit. Our judgments are based on subjective listening tests as well as objective, quantifiable test results. If a board's measured performance fell slightly below our accepted threshold but sound quality did not seem to diminish, we did not penalize the board.

If you intend to listen to audio CDs, indulge in multimedia applications, or play games, you should pay particular attention to the Preamplifier and Digital Playback test results. Multimedia presentation authors should examine the Preamplifier and Digital Recording tests.

TIER 1

The sound boards that fall into this category should be considered for all types of multimedia work, including high-quality multimedia authoring. To make it into this category, boards had to have excellent results on the Preamplifier, Digital Playback, and Digital Recording tests. Desirable characteristics include virtually flat frequency response from at least 20 Hz to 19,000 Hz, total harmonic distortion plus noise (THD+N) below 0.05 percent, A-weighted signal-to-noise (S/N) ratio above 75 dBr, channel separation better (with a larger negative number) than -75 dBr, quantization noise better (with a larger negative number) than -70 dB, intermodulation distortion below 0.01 percent, and dynamic range of a 1-kHz signal above 75 dB. Sound boards in this category are the Turtle Beach MultiSound Monterey and the Turtle Beach Tropez.

TIER 2

Sound boards in this group should be considered for most multimedia applications, including games, edutainment, and business presentations; however, they are not ideal for high-end audio work or high-quality multimedia authoring.

Audio Performance Glossary

Frequency response indicates how well a board or speakers reproduce sounds ranging from deep bass to high treble. Ideally, the component should handle all frequencies from 20 Hz to 20,000 Hz uniformly. Such a frequency response curve, when plotted, would yield a straight line at **0 relative decibels** (dBr), though a dropoff of 2 dB or so can be expected above 18,000 Hz because of the sharp treble cutoff filter. Less fluctuation equals better sound reproduction; a level below -3 dBr is unacceptable.

The **signal-to-noise ratio** (S/N ratio) is the ratio, in dBr, of the maximum undistorted output of the board (the signal) and the inevitable electronic noise—mostly hum and hiss—generated by the board's own circuitry. At the background level where such noise occurs, the human ear does not perceive all frequencies equally. So a standardized *A-weighting* network has been developed to reflect the "perceptible annoyance" value of residual electronic noise. On the tables we report this A-weighted signal-to-noise ratio. The larger the number, the better (quieter) the board. Note that a score below 75 dB means that background hum and hiss will underly the sound being reproduced and may become audible during silent passages.

With digital sound equipment, **quantization noise** serves as a more accurate guide to residual noise than the usual S/N figures do. Quantization noise is caused by the imperfect signal conversion from analog to digital or digital to analog. It is measured in the presence of a signal and is listed as the number of dB below the maximum signal. The lower the score (the larger the negative number), the better the sound quality.

In addition to noise, distortion is a problem with sound-reproducing components. The integrated circuit amplifiers of audio components generate unwanted harmonics, which alter the timbre of the music signals passed through them. The **total harmonic distortion plus noise** (THD+N) is the total of all spurious harmonic frequencies (plus the noise) generated within the board; it is expressed as a percentage of the undistorted output signal strength. THD+N values that exceed 0.1 percent are likely to be audible and indicate that the component has less than optimal circuitry.

Channel separation is simply the degree to which left- and right-channel signals remain distinct from one another. Ideally, channel separation (on which the stereo effect directly depends) should be infinite—meaning that no signal whatsoever leaks from one channel into the other. Crossover in excess of 50 dB would likely mask the beneficial effects of stereo imaging.

Dynamic range is the difference, expressed in dB, between the highest signal a device can handle and the lowest signal discernible from the residual noise. We measured the dynamic range at 1 kHz. An ideal digital audio system should approach a dynamic range of 98 dB.

Whenever the signal consists of two or more frequencies that are not harmonically related (which is the case with most sound we hear), there will be distortion by-products: spurious frequencies generated by the amplifier. These tend to add a strident, harsh edge to the sound. **Intermodulation distortion** is the amplitude ratio (expressed in percent) of the distortion to the test signal. We performed the CCIF Twin-Tone Intermodulation Distortion Test, which calls for test signals consisting of 11 kHz and 12 kHz at equal amplitude, and measured the distortion level. Lower scores are preferable; better audio components will produce intermodulation distortion levels below 0.1 percent.

Potential gain is the maximum amplification, in dB, that the preamplifier can achieve. In order to accommodate sound sources with various output levels and record them at constant volume, high potential gain at low voltage input is desired. We measured the potential gain with an input of 0.2V, which is a typical level of output from tape decks.

These boards generally displayed frequency response of ±3 dBr between 40 Hz and 17,000 Hz, THD+N below 0.1 percent, A-weighted S/N ratio above 65 dBr, channel separation better (with a larger negative number) than -60 dBr, quantization noise better (with a larger negative number) than -60 dB, intermodulation distortion lower than 0.03 percent, and dynamic range of a 1-kHz signal above 65 dB. Tier 2 boards include the Advanced Gravis UltraSound Max, Antex Z1e, Aztech WaveRider 32+, Best Data ACE 5000, Creative Labs Sound Blaster AWE32 Value Edition, Creative Labs Sound Blaster AWE32, Ensoniq Soundscape, Genoa AudioBlitz 3D, MediaMagic Telemetry-32, Mediatrix Audiotrix Pro, miroSound PCM 1 PRO, and New Media .WAVjammer.

TIER 3

This category includes sound boards that offer performance acceptable for playing games and edutainment titles but that generally should not be used for multimedia recording. To be considered for this category, sound boards had to display frequency response of ±3 dBr between 60 Hz and 15,000 Hz, THD+N below 0.2 percent, channel separation better (with a larger negative number) than -50 dBr, quantization noise better (with a larger negative number) than -50 dB, and dynamic range of a 1-kHz signal above 60 dB. Sound boards in this tier include the Boca Research SoundExpression, Creative Labs Sound Blaster 16 Value Edition, Logitech SoundMan Wave, Media Vision Premium 3-D, Media Vision Pro 3-D, Orchid SoundWave 32 Pro SCSI, Orchid SoundWave 32+ Studio, Reveal SoundFX, and Reveal SoundFX Wave.

TIER 4

Sound boards in this category are not suitable for audio work requiring true sound quality, but they may be acceptable for games and edutainment for the less demanding. Be prepared, however, to hear noticeable background noise and distortion and unrealistic musical effects. This category includes the ACS LaserWave Nucleus 16, Adaptec AudioEdge, Adaptec SCSI AudioMachine, KYE Genius SoundMaker 16E/Value Edition, Multiwave Audiowave Green 16, and Turtle Beach Monte Carlo.

How We Tested

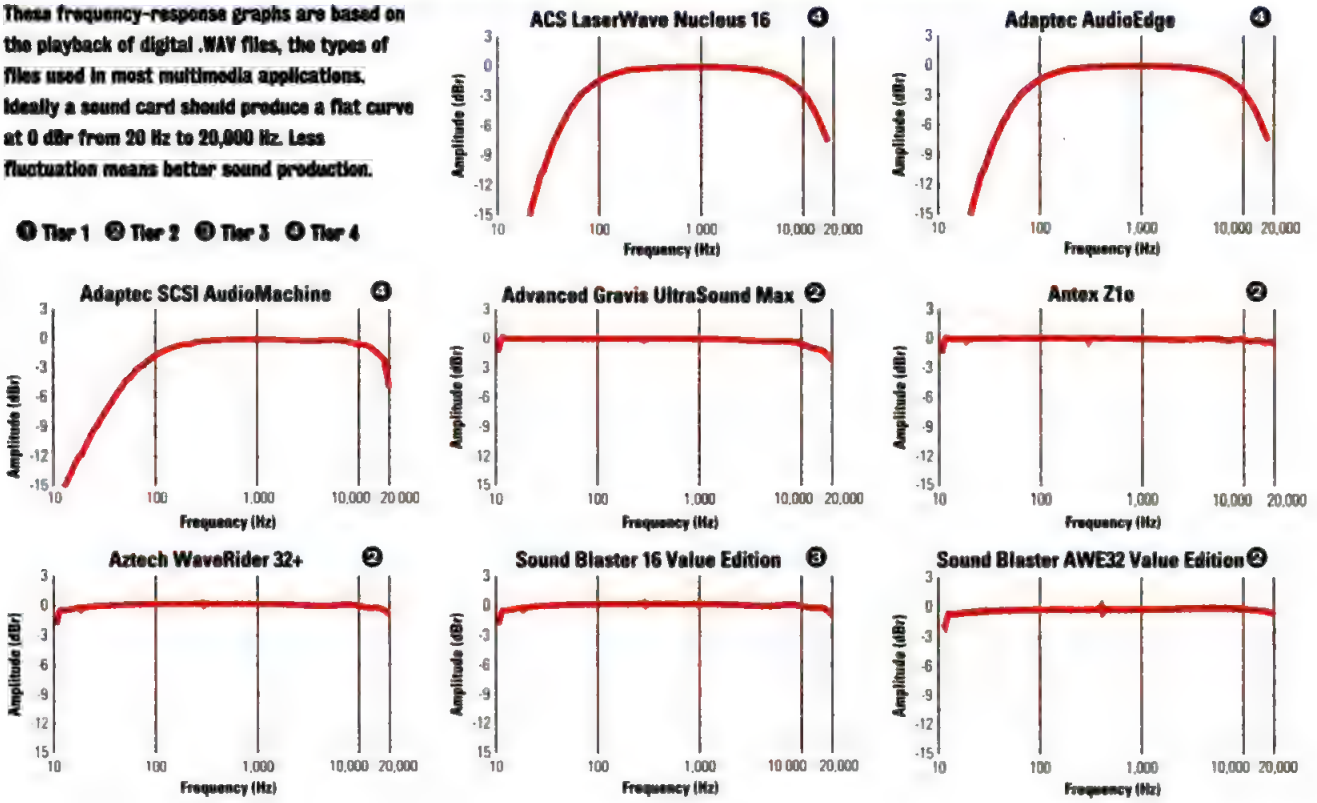
The Audio Precision System One (APSO) was used to generate and analyze test signals, except for the Digital Playback tests, where we used C-code-generated .WAV test files. All boards were tested in 16-bit stereo mode at a 44.1-kHz sampling rate so that we could determine whether the sound boards fulfill their claims of CD-quality recording and reproduction. To minimize the distortion introduced by the amplifier at its input or output, the sound boards were configured to unity gain. Calibration to unity gain ensures that the line-level signal strength is neither augmented nor diminished by the board's circuitry.

Our test-bed was a 486DX2/50-based Dell 450/ME with 8MB of RAM and a 300MB hard disk. DOS 6.22 and Microsoft Windows 3.1 formed the software platform.—*Analysis written by Jae Yang*

DIGITAL PLAYBACK: FREQUENCY RESPONSE

These frequency-response graphs are based on the playback of digital .WAV files, the types of files used in most multimedia applications. Ideally a sound card should produce a flat curve at 0 dBr from 20 Hz to 20,000 Hz. Less fluctuation means better sound production.

❶ Tier 1 ❷ Tier 2 ❸ Tier 3 ❹ Tier 4



Performance Tests: 16-Bit Sound Boards

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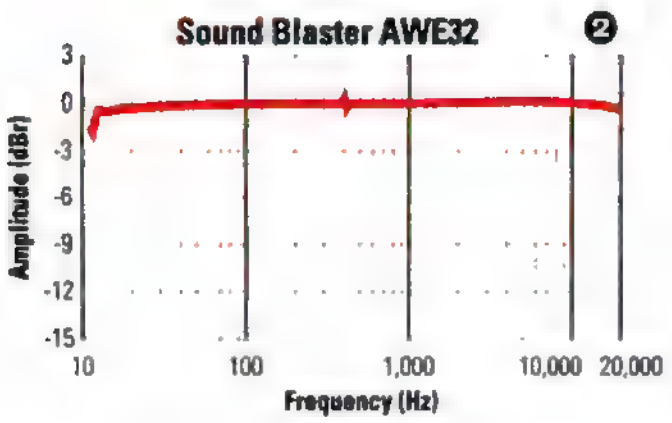

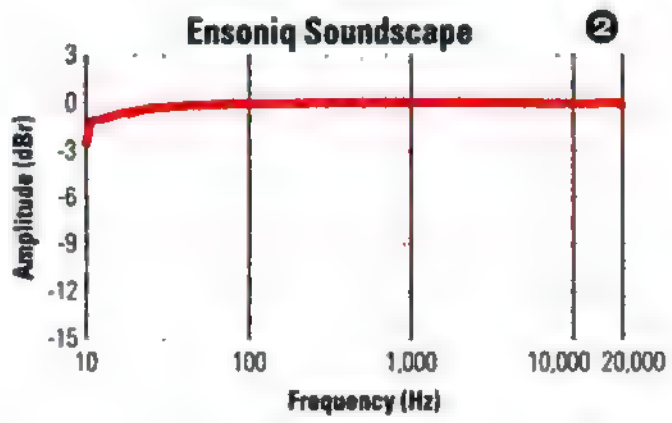

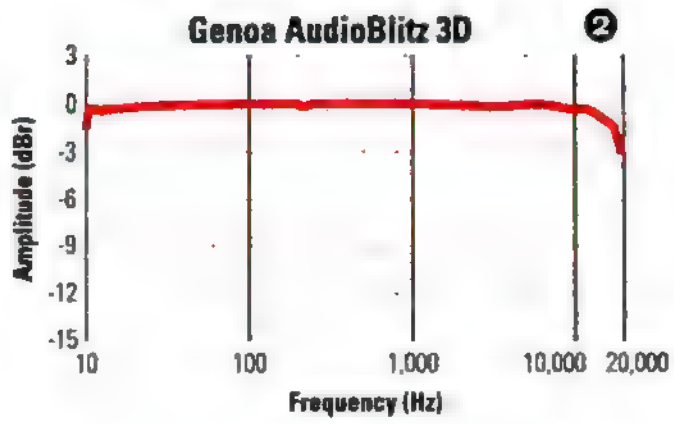

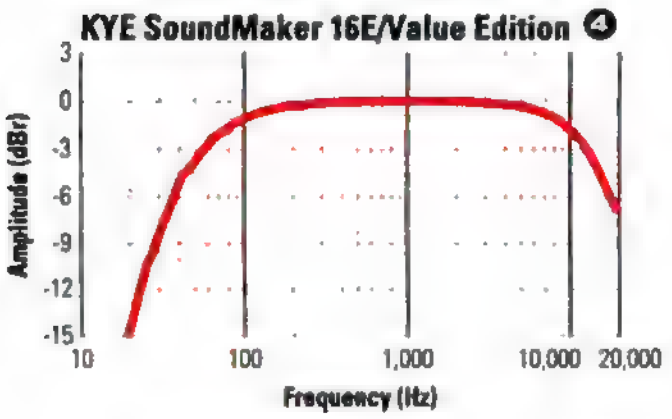

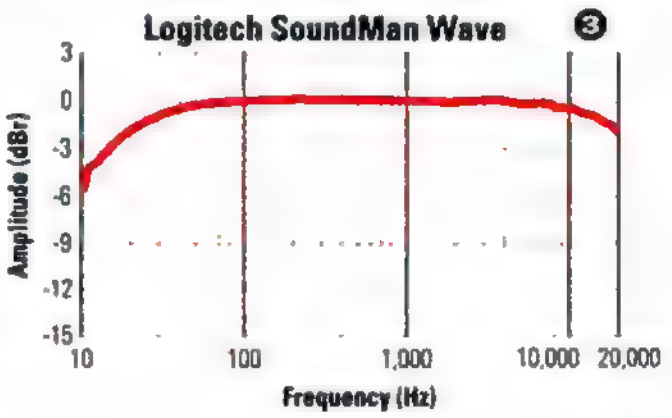

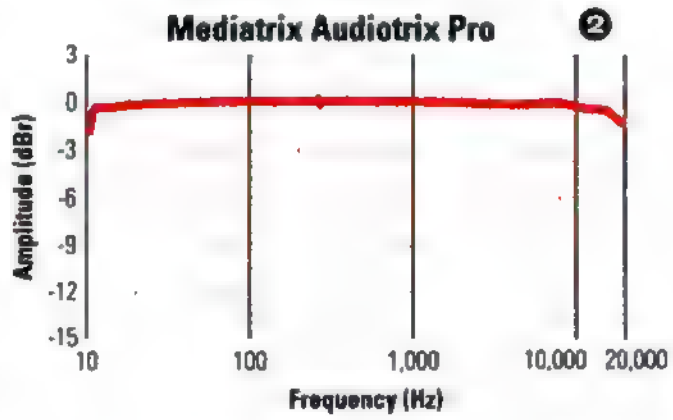

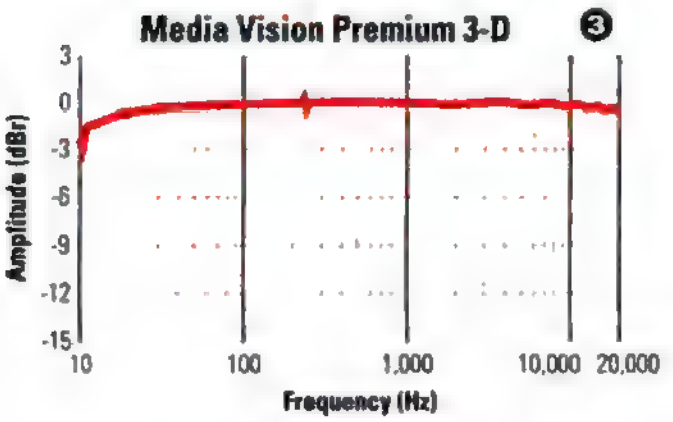

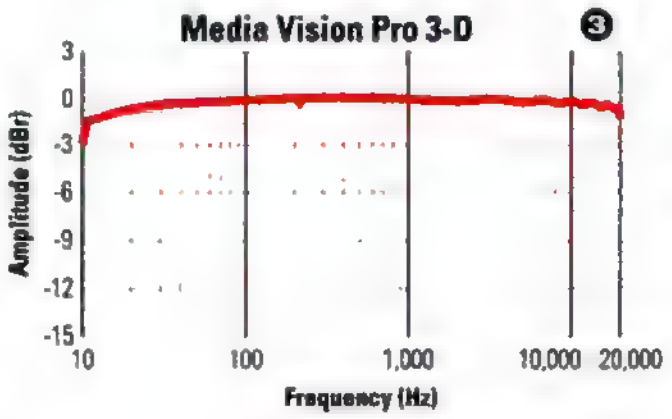

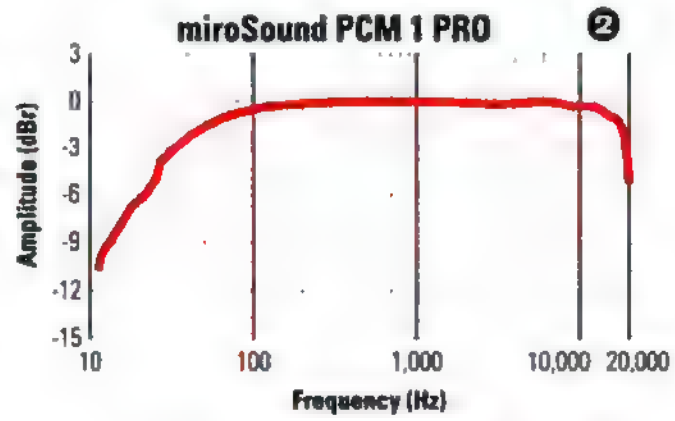

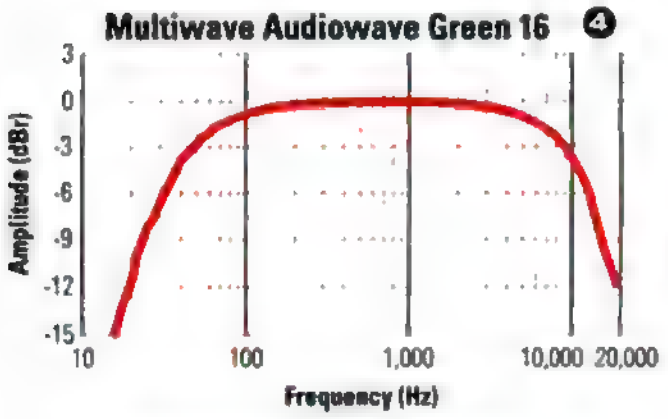

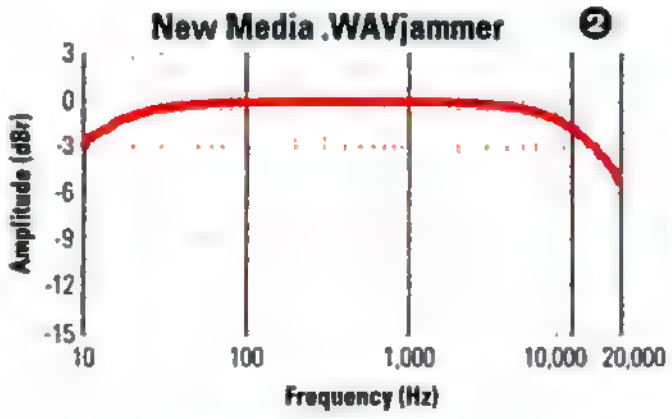

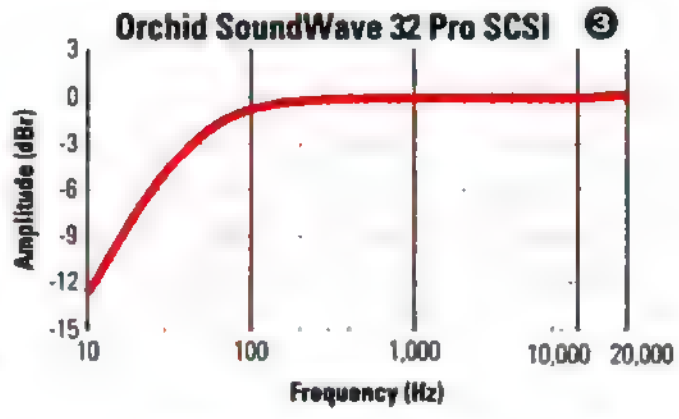

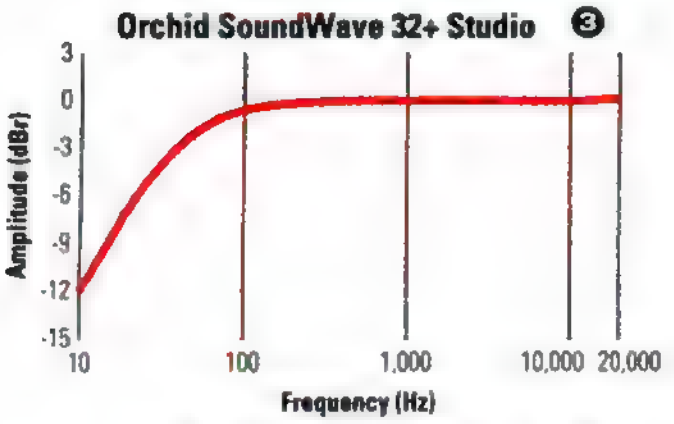

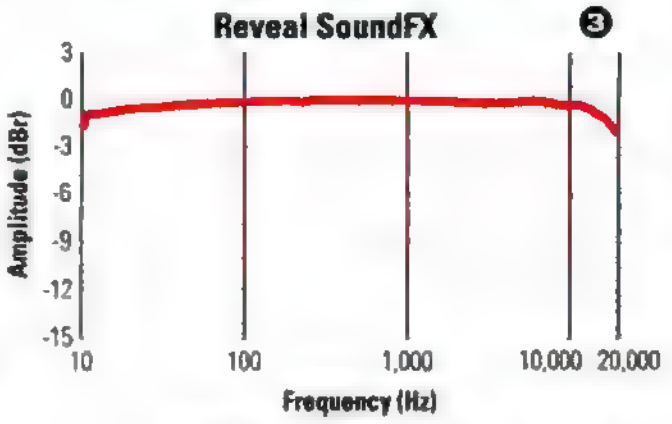

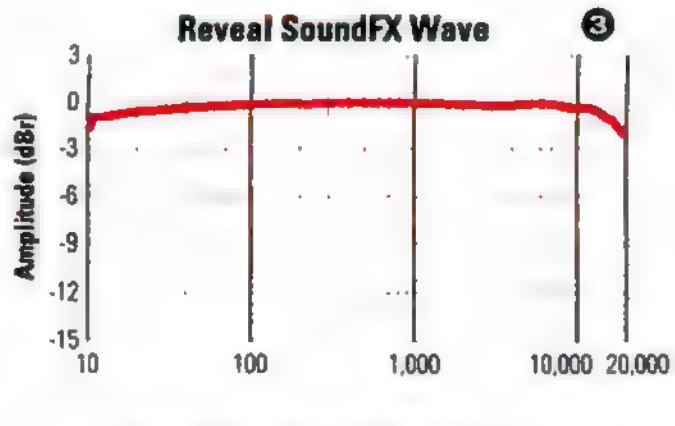

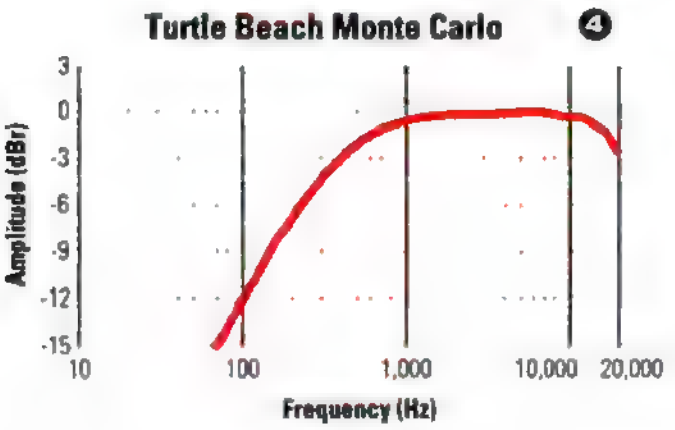

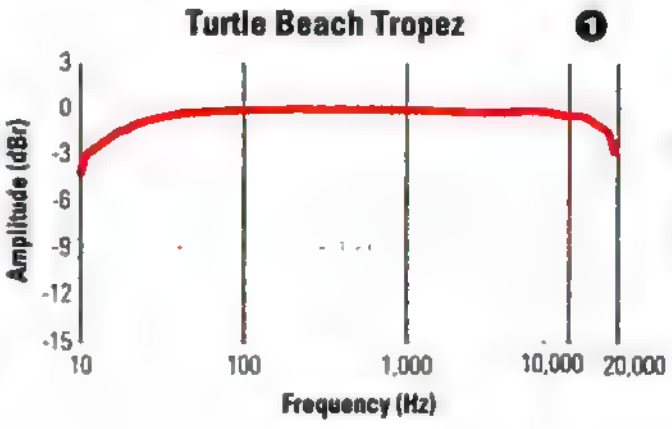

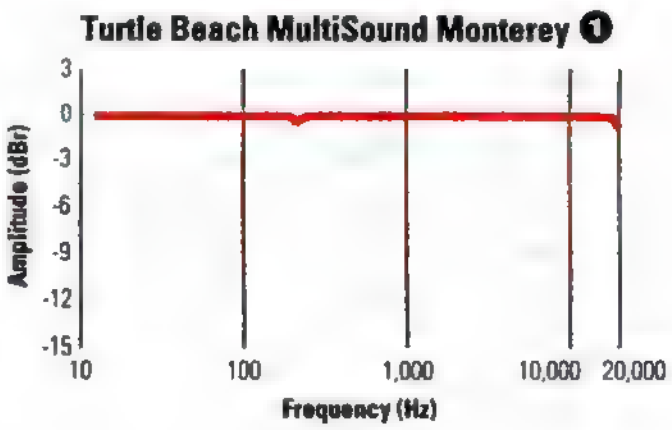

Sound Blaster
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SRP, $105.95

The smart decision.

Games are not the only software designed for Sound Blaster cards. Imagine a math program with a vast array of sound effects. It's mesmerizing. It's hypnotic. Especially if you have the Sound Blaster Pro Value Edition, the 8-bit sound card with stereo sound. It's compatible with Creative Labs CD-ROM drives, and comes with innovative sound utilities and recording software.

Sound Blaster 16
Value Edition
SRP, $139.95

The 16-bit decision.

The Sound Blaster 16 Value Edition is the best-selling sound card ever. It works with any Creative Labs CD-ROM drive and delivers stereo sound that meets MPC2 standards. It works with any speakers or headphones. And after experiencing a 16-bit game on Sound Blaster, you'll bolt to a nearby window, stick your reverberating head outside, and start screaming like a banshee, "I WANT 16-BIT SOUND!"

Tough decision. Choose one Sound Blaster or buy 5 more computers?

Sound Blaster
16 MultiCD
SRP, $199.95

With Advanced
Signal Processor
SRP, $249.95

The freedom decision.

Sound Blaster 16 MultiCD™ preserves your freedom of choice! It will connect a CD-ROM drive from manufacturers such as Sony, Mitsumi, and of course, Creative Labs. This 16-bit card is upgradeable to Wave Blaster™ II or an Advanced Signal Processor, the advanced technologies for MIDI music and more demanding sound-enhanced programs.

Sound Blaster
16 SCSI-2
SRP, $249.95

With Advanced
Signal Processor
SRP, $299.95

The I-want-it-all decision.

Sound Blaster 16 SCSI-2 delivers everything and compromises nothing. It's 16-bit sound with an optional Advanced Signal Processor and a collection of sound utilities. But best of all, it connects the sound card and up to six SCSI devices to a single port.

Sound Blaster
AWE32
Value Edition
SRP, $329.95

With Advanced Signal
Processor SRP, $399.95

The next wave decision.

The next generation of games will arrive with sound so real, you'll have to hang on to your headphones. Only Sound Blaster AWE32 can deliver the ultimate CD-quality sound. Real instrument samples and real sound effects. It's a 16-bit card with Advanced WavEffects™ and an optional Advanced Signal Processor. And other cool stuff. Like QSound, a 180° soundscape of intense virtual audio. Sound Blaster AWE32 has it all.

Of course, all Sound Blaster cards are easy to install and provide 100% compatibility with all software written for the Sound Blaster audio platform. Make your decision and visit your nearest Creative Labs dealer. Or call 1-800-998-5227 Ext. 111

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CIRCLE 072 ON READER SERVICE CARD

Performance Tests: 16-Bit Sound Boards

CONTINUES

PREAMPLIFIER

TEST DESCRIPTION The preamplifier is the mixer portion of a board, which controls the various analog inputs and outputs. These tests measure the line-level analog input and output of each board, bypassing the digital component. We use the APSO generator to create test tones and pass those signals through the board's line-level input; we then use the APSO analyzer to monitor line-level output. We report results for Frequency Response, Signal-to-Noise (S/N) Ratio (A-weighted), Channel Separation, Total Harmonic Distortion plus Noise (THD+N), Intermodulation Distortion, and Potential Gain.

	Frequency Response at -3dBr (Hz) *	Signal-to-Noise Ratio (A-weighted, in dBr) ▲	Channel Separation (dBr): Left to right ▼	Right to left ▼	Total Harmonic Distortion plus Noise (percent) ▼	Intermodulation Distortion (percent) ▼	Potential Gain (at 0.2 volts, in dB) ▲
ACS LaserWave Nucleus 16	**50–19,601**	**80.2**	**-68.7**	**-52.0**	**0.054**	**0.049**	**-0.54**
Adaptec AudioEdge	101–22,000	63.4	-76.9	-75.6	0.163	0.032	5.76
Adaptec SCSI AudioMachine	**80–22,000**	**63.2**	**-75.5**	**-74.2**	**0.171**	**0.035**	**6.04**
Advanced Gravis UltraSound Max	10–22,000	74.1	-70.3	-69.2	0.028	0.023	12.33
Antex Z1e	**10–22,000**	**76.5**	**-84.3**	**-83.9**	**0.024**	**0.010**	**-0.13**
Aztech WaveRider 32+	10–22,000	72.9	-91.4	-91.2	0.076	0.003	6.85
Best Data ACE 5000	**10–19,601**	**69.2**	**-79.1**	**-78.4**	**0.027**	**0.004**	**-2.32**
Boca Research SoundExpression	18–14,970	78.4	-77.5	-76.2	0.018	0.002	2.73
Creative Labs Sound Blaster 16 Value Edition	**10–22,000**	**74.9**	**-83.3**	**-84.5**	**0.103**	**0.036**	**5.92**
Creative Labs Sound Blaster AWE32 Value Edition	10–22,000	72.2	-85.2	-82.6	0.049	0.028	5.73
Creative Labs Sound Blaster AWE32	**10–22,000**	**78.7**	**-91.5**	**-83.3**	**0.039**	**0.015**	**5.98**
Ensoniq Soundscape	10–22,000	80.3	-44.6	-44.7	0.050	0.019	4.71
Genoa AudioBlitz 3D	**10–22,000**	**78.4**	**-78.2**	**-81.6**	**0.031**	**0.002**	**2.95**
KYE Genius SoundMaker 16E Value Edition	66–22,000	77.1	-69.2	-50.8	0.030	0.052	-1.36
Logitech SoundMan Wave	**10–22,000**	**70.4**	**-86.3**	**-88.3**	**0.046**	**0.008**	**-3.22**
MediaMagic Telemetry-32	10–22,000	81.3	-87.3	-87.6	0.035	0.004	11.96
Mediatrix Audiotrix Pro	**10–22,000**	**78.2**	**-67.2**	**-67.0**	**0.018**	**0.002**	**10.97**
Media Vision Premium 3-D	10–22,000	67.8	-59.9	-61.4	0.053	0.015	11.57
Media Vision Pro 3-D	**10–22,000**	**71.2**	**-61.8**	**-59.7**	**0.039**	**0.011**	**11.15**
miroSound PCM 1 PRO	15–22,000	85.2	-92.8	-92.1	0.060	0.032	11.22
Multiwave Audiowave Green 16	**69–19,601**	**80.5**	**-73.5**	**-53.7**	**0.048**	**0.037**	**-0.40**
New Media .WAVjammer	10–13,340	82.1	-76.7	-78.2	0.011	0.002	0.87
Orchid SoundWave 32 Pro SCSI	**45–21,170**	**70.1**	**-72.3**	**-71.0**	**0.092**	**0.023**	**9.53**
Orchid SoundWave 32+ Studio	40–21,170	74.1	-73.6	-71.2	0.054	0.022	9.25
Reveal SoundFX	**50–22,000**	**65.2**	**-50.3**	**-50.2**	**0.027**	**0.006**	**0.87**
Reveal SoundFX Wave	43–22,000	74.8	-52.6	-52.3	0.044	0.013	7.53
Turtle Beach Monte Carlo	**358–22,000**	**63.2**	**-18.7**	**-18.7**	**0.167**	**0.015**	**12.29**
Turtle Beach Tropez	14–22,000	86.5	-76.7	-80.1	0.009	0.001	10.64
Turtle Beach MultiSound Monterey	**10–19,601**	**77.2**	**-87.2**	**-82.1**	**0.019**	**0.001**	**18.91**

* We measured frequency response in the range from 10 Hz to 22,000 Hz; a larger range represents better performance

▲ Higher scores represent better performance. ▼ Lower scores (or larger negative numbers) represent better performance.

DISCUSSION Since any signal going in or out of the sound card must pass through the preamplifier, the quality of this circuitry is very important to the overall sound quality. The Turtle Beach Tropez had the best A-weighted S/N ratio (at 86.5 dBr) and the best THD+N (at 0.009 percent). The Turtle Beach Monte Carlo, on the other hand, had the worst overall scores of any board, which is a disappointment in view of Turtle Beach's prominance in the sound card market. More sound boards had impressive test results than in previous roundups. This year, the Genoa AudioBlitz 3D, the Mediatrix Audiotrix Pro, the miroSound PCM 1 PRO, the Turtle Beach MultiSound Monterey, and the Turtle Beach Tropez stood out from the crowd.

dows 95 is released, and with the release date delayed until at least August, we advise you to be skeptical of any one-step plug-and-play claims from sound cards makers before then. Plug and Play–ready ISA peripherals need special firmware that interacts with Plug and Play utilities to resolve IRQ, DMA, and other conflicts automatically. None of the ISA sound cards we looked at had this firmware.

In general, however, we were able to install most of the boards without difficulty; most used software-selectable IRQ and DMA settings rather than jumpers and DIP switches. In several cases, getting Sound Blaster compatibility to work for DOS games required extra effort. Additional, anecdotal tests confirmed that coordinating all the settings for Windows and DOS can take hours or even days, depending on what's in your PC and the level of technical assistance available from the vendor. To be safe, make sure the manufacturer you choose has toll-free technical support—and long hours. Two vendors in this roundup, Logitech and Reveal Computer Products, offer 7-day, 24-hour support.

THE FUTURE OF PC SOUND

Sound capabilities continue to be integrated with other components. Although digital signal processors (DSPs) are used in 15 of the boards we review, most cards still rely on less-expensive application-specific integrated circuits (ASICs). DSPs can combine several functions onto a single board, but so far only a few companies offer products that combine modem, fax, and sound capabilities (see the sidebar "Voice Mail for All"). Intel claims it may eliminate the need for DSPs with its own approach. Dubbed Native Signal Processing, Intel's

CONTINUES

POWER AMPLIFIER

TEST DESCRIPTION The Power Amplifier tests measure the amplified analog output of each sound board, bypassing the digital components. We use the APSO generator to create test tones and pass those signals through the board's line-level input; we then use the APSO analyzer to monitor amplified output using both a 4-ohm and an 8-ohm load (to simulate the load of a set of loudspeakers). We report test results for Frequency Response, Maximum Power Output (at both 4 ohms and 8 ohms), Signal-to-Noise (S/N) Ratio (A-weighted) at 0.5 watts and maximum power output, Channel Separation at 0.5 watts, and Total Harmonic Distortion plus Noise (THD+N) at 0.5 watts and maximum power output.

	Frequency Response at -3 dBr (Hz) *	Maximum Power Output (watts) ▲		Signal-to-Noise Ratio (A-weighted, in dBr) ▲		Channel Separation at 0.5W (dBr) ▼		Total Harmonic Distortion plus Noise (percent) ▼	
		4 ohms	8 ohms	0.5W	Maximum	Left to right	Right to left	0.5W	Maximum
ACS LaserWave Nucleus 16	**71–19,001**	**2.08**	**1.38**	**76.9**	**79.3**	**-45.6**	**-41.5**	**0.070**	**0.066**
Adaptec AudioEdge	122–22,000	1.60	1.32	79.4	81.5	-43.5	-44.0	0.157	0.230
Adaptec SCSI AudioMachine	**109–22,000**	**2.07**	**1.38**	**80.1**	**83.7**	**-43.4**	**-43.7**	**0.122**	**0.137**
Advanced Gravis UltraSound Max	69–22,000	0.81	0.53	80.7	83.9	-47.7	-46.9	0.231	0.214
Antex Z1e	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Aztech WaveRider 32+	52–22,000	1.90	1.32	74.1	78.2	-45.2	-45.1	0.109	0.151
Best Data ACE 5000	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Boca SoundExpression	56–15,560	1.42	1.13	77.1	79.3	-37.4	-37.4	0.077	0.076
Creative Labs Sound Blaster 16 Value Edition	**43–22,000**	**1.45**	**0.95**	**78.7**	**80.6**	**-43.7**	**-41.9**	**0.224**	**0.216**
Creative Labs Sound Blaster AWE32 Value Edition	43–22,000	1.33	0.78	79.8	75.1	-45.8	-47.9	0.104	0.109
Creative Labs Sound Blaster AWE32	**45–22,000**	**1.13**	**0.67**	**75.4**	**75.1**	**-43.3**	**-41.8**	**0.041**	**0.054**
Ensoniq Soundscape	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Genoa AudioBlitz 3D	**43–22,000**	**2.03**	**1.34**	**79.6**	**83.6**	**-42.1**	**-42.1**	**0.068**	**0.109**
KYE Genius SoundMaker 16E/Value Edition	86–22,000	0.03	0.60	84.5	85.6	-47.1	-42.5	0.700	0.721
Logitech SoundMan Wave	**20–22,000**	**2.20**	**1.47**	**71.6**	**74.1**	**-44.6**	**-44.8**	**0.140**	**0.150**
MediaMagic Telemetry-32	78–22,000	1.55	0.89	81.8	84.9	-42.5	-43.2	0.081	0.077
Mediatrix Audiotrix Pro	**45–22,000**	**0.78**	**0.51**	**85.6**	**N/A**	**-48.6**	**-48.4**	**0.595**	**N/A**
Media Vision Premium 3-D	28–22,000	1.42	1.60	70.0	68.7	-44.3	-44.3	0.206	0.246
Media Vision Pro 3-D	**21–22,000**	**1.93**	**1.57**	**71.4**	**71.3**	**-45.7**	**-45.4**	**0.207**	**0.346**
miroSound PCM 1 PRO	50–22,000	0.30	0.69	78.9	79.7	-43.8	-45.1	0.122	0.133
Multiwave Audiowave Green 16	**90–18,861**	**2.10**	**1.41**	**80.2**	**83.6**	**-45.1**	**-41.9**	**0.091**	**0.091**
New Media .WAVjammer	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Orchid SoundWave 32 Pro SCSI	**52–21,170**	**1.52**	**1.32**	**73.4**	**73.9**	**-41.5**	**-41.5**	**0.567**	**0.467**
Orchid SoundWave 32+ Studio	50–21,170	1.81	1.46	70.5	71.0	-42.2	-42.5	0.582	0.494
Reveal SoundFX	**77–22,000**	**1.50**	**1.24**	**84.2**	**87.0**	**-40.7**	**-40.6**	**0.159**	**0.198**
Reveal SoundFX Wave	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Turtle Beach Monte Carlo	**332–22,000**	**1.72**	**1.12**	**69.4**	**72.3**	**-17.7**	**-17.7**	**0.110**	**0.129**
Turtle Beach Tropez	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Turtle Beach MultiSound Monterey	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**

* We measured frequency response in the range from 10 Hz to 22,000 Hz, a larger range represents better performance
▲ Higher scores represent better performance. ▼ Lower scores (or larger negative numbers) represent better performance
N/A—Not applicable: The product does not have an on-board amplifier

DISCUSSION At maximum power, none of the boards exhibited adequate sound amplification. Although many vendors claim maximum power output of 4 watts per channel, all sound boards fell short of this figure. (We define maximum power output to be the maximum strength signal with THD+N below 1.0 percent; THD+N above 1.0 percent is too severely distorted to be considered usable.) The KYE Genius SoundMaker 16E/Value Edition and the miroSound PCM 1 PRO boards in particular had the lowest maximum power output, with nearly negligible amplification. Both of these boards must be used with powered speakers.

design for the future is to use software codecs on 100-MHz or better Pentium systems without adding any hardware. Ideally, a system could then juggle communications and audio functions on its own.

CONNECTIONS

Remember to check that the card's inputs and outputs match your needs. Typically, the sound card will offer at least one stereo low-level input (for an external CD-ROM drive) and one stereo line output. Line outputs are intended for external amplifiers or recording devices, such as a tape deck. Some cards also offer variable (amplified) line outputs (adjusted via software volume controls), which can be hooked up to speakers; we recommend you use powered speakers with a low-level output if possible. Other connections often include a separate microphone input with amplification to boost the signal and a joystick/MIDI port. Some cards also come with a volume dial in the back. Make sure that the sound board has external labels over its ports so you don't have to consult your manuals every time you plug something in.

As a final consideration, you'll probably want your sound board to work in conjunction with an internal CD-ROM drive. If you already have one installed, all you need to do is connect its analog audio output to an internal connection on the sound card (the cable should be supplied with the CD-ROM drive). Make sure the connector has the right number of pins for your card; currently some have three and some have four. If you don't already own a CD-ROM drive or are buying it separately,

Performance Tests: 16-Bit Sound Boards

CONTINUES

DIGITAL PLAYBACK

TEST DESCRIPTION The Digital Playback tests determine the amount of degradation caused by the digital-to-analog conversion process that a sound board uses to play back prerecorded digital audio files. For this battery of tests, we wrote our own C code for digital .WAV file test tones (according to Microsoft's specification for .WAV files), and we play them through the line-level output of each board. Since these prerecorded digital audio files are computer-generated, they can be considered pure. We use the APSO analyzer to measure Frequency Response, Quantization Noise, Channel Separation, Total Harmonic Distortion plus Noise, Intermodulation Distortion, and Dynamic Range.

	Frequency Response at -3 dBr (Hz) *	Quantization Noise (dB) ▼	Channel Separation (dBr): Left to right ▼	Channel Separation (dBr): Right to left ▼	Total Harmonic Distortion plus Noise (percent) ▼	Intermodulation Distortion (percent) ▼	Dynamic Range at 1 kHz (dB) ▲
ACS LaserWave Nucleus 16	66–10,299	-54.5	-66.8	-51.8	0.328	0.083	65.8
Adaptec AudioEdge	66–10,299	-59.7	-77.6	-75.9	0.087	0 021	62 7
Adaptec SCSI AudioMachine	75–17,861	-59.6	-74.1	-72.5	0.085	0.032	61.4
Advanced Gravis UltraSound Max	10–22,000	-68.3	-83.5	-86.5	0.035	0.027	71.1
Antex Z1e	11–22,000	-72.7	-93.3	-94.7	0.028	0.022	81.0
Aztech WaveRider 32+	10–22,000	-69.0	-88.6	-88.7	0.060	0.004	74.7
Best Data ACE 5000	10–22,000	-72.1	-94.0	-91.5	0.020	0.003	70.4
Boca SoundExpression	17– 12,234	-71.1	-75.4	-74.3	0.017	0.008	81.2
Creative Labs Sound Blaster 16 Value Edition	11–22,000	-67.2	-86.9	-85.5	0.121	0.061	69.4
Creative Labs Sound Blaster AWE32 Value Edition	10–22,000	-67.0	-85.1	-79.8	0.037	0.009	73.3
Creative Labs Sound Blaster AWE32	11– 22,000	-70.4	-87.1	-80.2	0.035	0.007	75.1
Ensoniq Soundscape	10– 21,170	-65 4	-72.3	-72.4	0.040	0.003	74.8
Genoa AudioBlitz 3D	10–17,464	-68.3	-75.4	-73.8	0.031	0.005	72.2
KYE Genius SoundMaker 16E/Value Edition	57–11,816	-55 8	-67.7	-50 4	0.190	0 063	63 2
Logitech SoundMan Wave	15–22,000	-53.3	-87.2	-87.9	0.160	0.023	63.0
MediaMagic Telemetry-32	10–19,591	-69.7	-87.4	-85.2	0.080	0.021	67.3
Mediatrix Audiotrix Pro	10–22,000	-72.5	-83.2	-80.2	0.018	0.002	80.0
Media Vision Premium 3-D	10–22,000	-53.0	-72.5	-59.0	0.165	0.021	66 8
Media Vision Pro 3-D	10–20,370	-52.9	-72.2	-58.8	0.165	0.029	67.4
miroSound PCM 1 PRO	34–18,861	-69.9	-75.1	-73.0	0.031	0.008	76.7
Multiwave Audiowave Green 16	51–8,311	-56.8	-69.0	-53.4	0.264	0.078	65.9
New Media .WAVjammer	10–13,864	-77.3	-70.5	-70.1	0.021	0.002	74.2
Orchid SoundWave 32 Pro SCSI	45–21,170	-65.3	-78.6	-71.4	0.049	0.028	62.8
Orchid SoundWave 32+ Studio	40–21,170	-65.4	-79.2	-71.4	0.046	0.005	61.4
Reveal SoundFX	10–22,000	-72.2	-49.8	-49.7	0.069	0.003	68.6
Reveal SoundFX Wave	10–22,000	-72.9	-50.1	-50.0	0 022	0 014	69.5
Turtle Beach Monte Carlo	448–22,000	-54.9	-18.7	-18.7	0.269	0.022	67.8
Turtle Beach Tropez	11–17,383	-72.3	-75.9	-73.5	0.019	0 003	80.4
Turtle Beach MultiSound Monterey	12–22,000	-71.5	-94.6	-95.7	0.019	0.001	82.9

* We measured frequency response in the range from 10 Hz to 22,000 Hz; a larger range represents better performance
▲ Higher numbers represent better performance. ▼ Lower numbers (or larger negative numbers) represent better performance

DISCUSSION For most users of multimedia games and business and edutainment applications, more than 90 percent of sound card activity involves digital playback. This makes the quality of the digital-to-analog converter (DAC) very important in determining the effectiveness of sound boards in general multimedia environments. Six boards excelled in digital playback: the Antex Z1e, the Advanced Gravis UltraSound Max, the Creative Labs Sound Blaster AWE32, the Mediatrix Audiotrix Pro, the Turtle Beach MultiSound Monterey, and the Turtle Beach Tropez. The Turtle Beach Monte Carlo had some of the worst scores on these tests.

consider the controller options. Some sound cards come standard with built-in SCSI-2 (popular on higher-end quad-speed CD-ROM drives), Enhanced IDE (increasingly popular), or proprietary CD-ROM controllers.

No matter what your needs may be, there's a sound board in this roundup that will meet your demands. Once you've found the one that's right for your system, you'll need speakers to match. For more help on finding multimedia speakers, see the sidebar "Powered Speakers: Just Listen."

ACS/KRIS Technologies Inc.

• ACS LaserWave Nucleus 16

Multiwave Innovation Inc.

• Multiwave Audiowave Green 16

BY BENJAMIN F. MILLER AND JAE YANG

If all you need from a sound board are the bare essentials, consider the $79 ACS LaserWave Nucleus 16 from ACS/KRIS Technologies. This low-priced FM-synthesis sound board is acceptable for voice annotation and playing CD-ROM titles where high fidelity will not be missed. This same board is distributed by Multiwave Innovation as the Multiwave Audiowave Green 16 ($99 list, $89 street), which includes headphones and a microphone. We tested the Green 16 with its DreamWave wavetable daughtercard (a $79 option from Multiwave, $99 from ACS), but we were still disappointed with the sound quality.

Both boards were relatively easy to install, with a Windows-based installation program that identifies IRQ and memory-

Performance Tests: 16-Bit Sound Boards

DIGITAL RECORDING

TEST DESCRIPTION The Digital Recording tests isolate the analog-to-digital converter, thus measuring the sound board's ability to record. Test tones from the APSO signal generator are sent to the sound board in 16-bit, 44.1-kHz format. We then analyze the recorded digital .WAV files using the APSO's DSP. We report test results for Frequency Response, Quantization Noise, Channel Separation, Total Harmonic Distortion plus Noise, and Intermodulation Distortion.

	Frequency Response at -3 dBr (Hz) *	Quantization Noise (dB) ▼	Channel Separation (dBr): Left to right ▼	Channel Separation (dBr): Right to left ▼	Total Harmonic Distortion plus Noise (percent) ▼	Intermodulation Distortion (percent) ▼
ACS LaserWave Nucleus 16	**47–19,381**	**-60.08**	**-67.32**	**-55.23**	**0.342**	**0.0335**
Adaptec AudioEdge	17–19,730	-59.56	-69.98	-69.61	0.013	0.0139
Adaptec SCSI AudioMachine	**19–18,956**	**-60.01**	**-67.93**	**-69.02**	**0.012**	**0.0155**
Advanced Gravis UltraSound Max	14–18,975	-68.49	-75.35	-77.17	0.011	0.0216
Antex Z1e	**12–20,940**	**-63.59**	**-70.40**	**-69.15**	**0.014**	**0.0165**
Aztech WaveRider 32+	15–19,919	-62.45	-77.41	-77.70	0.011	0.0019
Best Data ACE 5000	**16–20,053**	**-64.31**	**-78.78**	**-76.91**	**0.013**	**0.0062**
Boca SoundExpression	13–19,242	-51.51	-71.43	-70.54	0.013	0.1036
Creative Labs Sound Blaster 16 Value Edition	**10–20,000**	**-65.99**	**-84.06**	**-85.98**	**0.122**	**0.0633**
Creative Labs Sound Blaster AWE32 Value Edition	15–20,000	-69.82	-86.43	-88.32	0.044	0.0219
Creative Labs Sound Blaster AWE32	**15–20,000**	**-66.98**	**-88.74**	**-89.32**	**0.030**	**0.0209**
Ensoniq Soundscape	39–20,065	-65.35	-44.45	-44.52	0.017	0.0172
Genoa AudioBlitz 3D	**14–20,000**	**-61.47**	**-69.45**	**-67.75**	**0.014**	**0.0038**
KYE Genius SoundMaker 16E/Value Edition	43–14,991	-60.11	-67.33	-52.44	0.195	0.0414
Logitech SoundMan Wave	**14–19,671**	**-69.80**	**-77.19**	**-75.30**	**0.011**	**0.0132**
MediaMagic Telemetry-32	11–17,343	-67.51	-97.21	-90.45	0.023	0.0225
Mediatrix Audiotrix Pro	**10–19,090**	**-65.82**	**-73.77**	**-78.91**	**0.021**	**0.0098**
Media Vision Premium 3-D	13–20,356	-71.28	-65.44	-63.35	0.034	0.0384
Media Vision Pro 3-D	**17–20,350**	**-69.04**	**-63.35**	**-61.44**	**0.028**	**0.0325**
miroSound PCM 1 PRO	15–20,000	-66.98	-84.63	-84.38	0.070	0.0622
Multiwave Audiowave Green 16	**68–12,429**	**-60.12**	**-66.35**	**-54.35**	**0.136**	**0.0424**
New Media .WAVjammer	13–19,753	-88.86	-79.44	-78.24	0.003	0.0033
Orchid SoundWave 32 Pro SCSI	**45–19,832**	**-64.49**	**-67.33**	**-97.27**	**0.011**	**0.0282**
Orchid SoundWave 32+ Studio	40–20,003	-65.72	-90.28	-105.30	0.031	0.0282
Reveal SoundFX	**50–3,818**	**-71.29**	**-51.69**	**-51.98**	**0.050**	**0.1629**
Reveal SoundFX Wave	47–3,966	-63.05	-52.34	-55.26	0.040	0.0626
Turtle Beach Monte Carlo	**368–18,806**	**-64.54**	**-18.89**	**-19.39**	**0.031**	**0.0230**
Turtle Beach Tropez	13–19,440	-75.83	-73.72	-73.61	0.012	0.0048
Turtle Beach MultiSound Monterey	**15–20,131**	**-79.75**	**-74.86**	**-74.10**	**0.013**	**0.0011**

* We measured frequency response in the range from 10 Hz to 22,000 Hz; a larger range represents better performance. ▼ Lower numbers (or larger negative numbers) represent better performance.

DISCUSSION To multimedia authors and those planning to do a lot of recording, this data may be the most crucial. The New Media .WAVjammer had the best overall performance on these tests, followed by the Turtle Beach MultiSound Monterey, the Turtle Beach Tropez, and the Mediatrix Audiotrix Pro. The KYE Genius SoundMaker 16E/Value Edition, the Multiwave Audiowave Green 16, and the ACS LaserWave Nucleus 16 were poor performers; the Turtle Beach Monte Carlo was the worst. The Reveal SoundFX displayed one of the smallest frequency response curves at -3 dBr that we have seen, running only from 50 Hz to 3,818 Hz.

address conflicts with your existing hardware and recommends alternatives. The inputs and outputs on the boards' backplanes are not labeled, which means you'll have to consult the manual each time you want to connect speakers or a microphone. The boards provide proprietary interfaces for Mitsumi, Panasonic, and Sony CD-ROM drives, as well as an optional SCSI daughterboard (about $25). The ESS 688F chip in both boards shuts off the power when the boardis not in use. The boards are Microsoft Windows Sound System–compatible but lack full Sound Blaster functionality: You can initialize the card in DOS, but the executables do not provide the information a game (such as DOOM) needs to utilize the cards' services.

SUITABILITY TO TASK

ACS LaserWave Nucleus 16

MIDI composition	**FAIR**
Business applications	**GOOD**
Multimedia authoring	**POOR**
Games and edutainment	**FAIR**

Software audio controls are rudimentary: The mixer allows only volume control and muting capabilities. There is a separate mixer control for recording, but it does not give the user enough control for multimedia authoring work. The software's most useful feature is a library of audio clips that are ideal for adding splashes of sound to business documents. The Green 16 also comes with applets to play MIDI files, .WAV files, and audio CDs.

The ACS LaserWave and the Green 16 turned in unacceptable marks on most of our tests. Digital playback frequency response was poor, as the units dropped sounds in both the low and high ends of the audio spectrum. THD+N also exceeded our 0.1 threshold, and the boards were among the worst performers on our Digital Recording tests. Digital playback was highly distorted and lacking in both bass and treble. Our 8-bit and 16-bit .WAV files produced fair sound, acceptable for voice applications; FM-synthesis MIDI files sounded artificial and produced an unacceptable amount of noise.

The meager FM synthesis of the Yamaha OPL3 can be replaced by adding a

SUITABILITY TO TASK Multiwave Audiowave Green 16	
MIDI composition	FAIR
Business applications	GOOD
Multimedia authoring	POOR
Games and edutainment	FAIR

Wave Blaster–compatible upgrade card (with the Green 16, we used Multiwave's DreamWave with the Crystal Dream wavetable synthesizer). Although the DreamWave was certainly a step up from FM-synthesis MIDI, its music is unimpressive compared with other wavetable cards. With only 24-note polyphony and 20-voice multitimbrality, this card is not appropriate for MIDI composers.

▶ **ACS LaserWave Nucleus 16.** List price: *$79.* ACS/KRIS Technologies Inc., *100 San Liucar Ct., Sunnyvale, CA 94086; 800-282-5747; fax, 408-481-0880.*

Circle 469 on reader service card

▶ **Multiwave Audiowave Green 16.** List price: *$99.* Multiwave Innovation Inc., *747 Camden Ave., Suite D, Campbell, CA 95008; 800-379-8558, 415-379-2900; fax, 415-379-3292.*

Circle 470 on reader service card

Adaptec Inc.

• Adaptec AudioEdge
• Adaptec SCSI AudioMachine

BY CHUL SUNG KIM

The Adaptec AudioEdge ($249 list) and the Adaptec SCSI AudioMachine ($349) might best be described as SCSI adapters with sound support thrown in. Microsoft Windows Sound System, which is bundled with each package, delivers voice recognition and other features targeted at the business user. Users looking for SCSI connectivity and modest sound capabilities in one package might be intrigued, but those who care about sound quality first should probably look elsewhere.

SUITABILITY TO TASK Adaptec AudioEdge	
MIDI composition	FAIR
Business applications	GOOD
Multimedia authoring	FAIR
Games and edutainment	FAIR

Both boards are equipped with 512K of wavetable ROM and an Analog Devices DSP to handle music synthesis and audio compression. The higher-priced AudioMachine delivers more SCSI niceties, such as a host-adapter BIOS (which lets you boot off of a drive attached to the adapter) and two SCSI connectors (which let the AudioMachine control internal and external devices). The AudioEdge lacks a BIOS, accommodates only internal devices, and doesn't support the XA format.

We were disappointed with Adaptec's wavetable implementation. The 512K of ROM is far too small to do justice to General MIDI's full complement of 128 instruments plus drums. The result is music that hardly sounds better than FM synthesis. Pianos, strings, brasses, and woodwinds all sound completely artificial; drums fare somewhat better. Sound on the popular games we tested is good enough to satisfy the occasional player, but joystick junkies will be left wanting.

The digital audio performance of the units also fell short on our tests. Bass response is poor, and THD+N and S/N Ratios are both among the worst in this roundup. The digital-to-analog converter produced particularly unimpressive Frequency Response numbers. Results on our Digital Recording tests were also subpar. The cards' Quantization Noise figures were among the worst we saw, and the Frequency Response curves showed weakness at both upper and lower ranges. The cards did show little intermodulation distortion.

Microsoft Windows Sound System includes a mixer panel, a .WAV file recorder/editor,an audio CD player, voice recognition software, and a microphone—but no MIDI sequencer. The .WAV file recorder allows drag-and-drop linking or embedding of OLE-compliant sound objects. We found the voice recognition to be fairly forgiving of variations in pronunciation, but the program handled some phrases better than others, and its configuration windows are confusing.

SUITABILITY TO TASK Adaptec SCSI AudioMachine	
MIDI composition	FAIR
Business applications	[illegible]
Multimedia authoring	FAIR
Games and edutainment	FAIR

The combination of SCSI capabilities and acceptable voice audio may suit business users. But if you're adding sound to your PC for fun, keep reading.

▶ **Adaptec AudioEdge.** List price: *$249.* **Adaptec SCSI AudioMachine.** List price: *$349.* Adaptec Inc., *691 S. Milpitas Blvd., Milpitas, CA 95035; 800-459-7274; fax, 408-262-2533.*

Circle 471 on reader service card

Advanced Gravis Computer Technology Ltd.

• Advanced Gravis UltraSound Max

BY BENJAMIN F. MILLER

Advanced Gravis Computer Technology is best known as a joystick manufacturer, but the Advanced Gravis UltraSound Max ($249 list, $170 street) is the company's second foray into the sound card market. With decent wavetable synthesis and good recording and playback quality, this card is appropriate for playing educational titles and games, as well as for multimedia authoring. Its performance should certainly please business users, but the card doesn't come with its own business applications; you'll have to buy your own copy of Microsoft Windows Sound System or another third-party app with business-audio features.

SUITABILITY TO TASK Advanced Gravis UltraSound Max	
MIDI composition	GOOD
Business applications	GOOD
Multimedia authoring	GOOD
Games and edutainment	EXCELLENT

The UltraSound Max's GF1 wavetable chip set is software-upgradeable, and Advanced Gravis plans to release CD-ROMs soon with patch libraries to expand the card's MIDI library. The company has noticeably upped the quality of the card's MIDI playback capabilities from the previous generation of UltraSound (reviewed in "Big Audio Dynamite," April 12, 1994). The card provides interfaces for Mitsumi, Panasonic, and Sony CD-ROM drives, but not for SCSI. The installation was straightforward, thanks to a DOS utility that lets you easily resolve conflicts between the sound card and other devices.

On our tests, the UltraSound Max showed excellent Frequency Response and Total Harmonic Distortion plus Noise results in both the digital and analog-to-digital domains. Its signal-to-noise ratio was also fine. Indeed, the UltraSound Max provided clear and well-defined sound in our sample business presentations and digital and analog music playback. This Sound Blaster–compatible card displayed partic-

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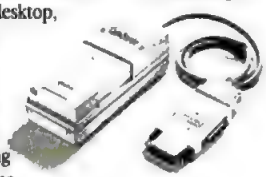
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PC MAGAZINE CIRCLE 106 ON READER SERVICE CARD

ularly strong playback capabilities while playing FM-synthesis MIDI and .WAV files used in games. Power from the amplifier was lower than with other cards—0.5 watts per channel over 8 ohms—so you'll want to use powered speakers.

The bundle includes Midisoft's Sound Impression and Recording Session. Sound Impression includes a mixer, an audio CD player, a .WAV file player/recorder, and a MIDI player with a graphical interface that simulates the look of a home stereo.

Advanced Gravis has done an admirable job with this iteration of the UltraSound, delivering good sound performance for playing CD-ROM titles and for multimedia authoring.

▶ **Advanced Gravis UltraSound Max.** List price: *$249.* Advanced Gravis Computer Technology Ltd., *101-3750 N. Fraser Way, Burnaby, B.C., Canada USJ 5E9; 800-663-8558, 604-431-5020; fax, 604-431-5155.*

Circle 472 on reader service card

Antex Electronics Corp.

• Antex Z1e

BY CHUL SUNG KIM

With a price of $595—$790 with the wavetable option—Antex Electronics Corp.'s Antex Z1e may not seem like a bargain. But if you need MPEG compression, the Antex may be one of the cheapest ways to get it. Its performance figures were consistently at the top (with one notable exception), and its recording features set this card apart.

SUITABILITY TO TASK Antex Z1e	
MIDI composition	GOOD
Business applications	GOOD
Multimedia authoring	EXCELLENT
Games and edutainment	FAIR

This card is clearly designed for heavy-duty digital audio production. It's not Sound Blaster–compatible, so you can forget about playing games requiring that standard. Instead, the Antex supports recording at 48 kHz and can use more audio-compression formats than any other card in this roundup. As well as uncompressed PCM, the Antex handles ADPCM, ADPCME, CDIB, CDIC, MSADPCM, and MPEG.

Why include MPEG, more often thought of as a video compression standard? The company claims that MPEG provides up to 12-to-1 compression while still delivering broadcast-quality audio. To enable MPEG compression, Antex built in more RAM and a floating-point (not fixed-point) DSP. Antex thoughtfully provides a demo miniapplication that lets you record and play back sounds in each format so you can compare quality and file size. You must provide your own editor, though the company plans to have one available (for $595) by the time you read this.

On our Digital Playback tests, the Antex's frequency response showed ideal flatness from 10 Hz all the way to our limit of 22 KHz. THD+N was low, and channel separation was very good. Digital Recording results were equally impressive, though the Antex showed a disappointing amount of quantization noise. Overall, the Antex produced results that were well above average but not quite as good as those of the Turtle Beach MultiSound Monterey or the Mediatrix Audiotrix Pro, each of which costs less.

The Antex came with the optional Z.Wav wavetable daughtercard. The daughtercard sports an Ensoniq synthesizer, a pair of 2MB ROMs to hold instrument samples, and a Motorola 68000 to coordinate music output. Despite the generous size of its ROMs, the Z.Wav's patches, to our ears, lacked the sparkle found on other chip sets. No MIDI sequencer is included.

For close to $600, you would expect the Antex to come with more than just a mixer panel and demo software. But those who really need the Antex's versatile audio compression features will appreciate that the card is indeed worth the price.

▶ **Antex Z1e.** List price: *$595; Z.Wav wavetable daughtercard, $195.* Antex Electronics Corp., *16100 S. Figueroa St., Gardena, CA 90248; 800-338-4231, 310-532-3092; fax, 310-532-8509.*

Circle 473 on reader service card

Aztech Labs Inc.

• Aztech WaveRider 32+

BY BENJAMIN F. MILLER

The most attractive aspect of Aztech Labs' Aztech WaveRider 32+ is its price. For $199 ($149 street), you get usable wavetable sound for business presentations and edutainment titles, plus the software to get you going. The card doesn't excel in any area and was disappointing when playing back MIDI files, but buyers on a budget might overlook such faults.

The WaveRider provides proprietary interfaces for Sony, Mitsumi, and Panasonic CD-ROM drives, as well as a separate controller that allows the board to work with all IDE drives (including Aztech's). The card features a software-controlled installation routine, though we did run into resource conflicts when we hooked it up to our test system. The card would not work with our CD-ROM drive attached to an Adaptec 1510 or Adaptec 1542 SCSI controller. Unable to resolve the conflict with the help of Aztech's technical support, we tested the card using a Future Domain 1610 SCSI adapter instead.

SUITABILITY TO TASK Aztech WaveRider 32+	
MIDI composition	FAIR
Business applications	FAIR
Multimedia authoring	FAIR
Games and edutainment	FAIR

The WaveRider achieved good results on our Frequency Response tests and produced sound suitable for business needs and the occasional game user. But MIDI files sounded synthetic, as if produced by a cheap electronic keyboard. The WaveRider showed acceptable performance on our Digital Recording tests. Its Quantization Noise figure was a little below average, but THD+N and Intermodulation Distortion scores were better than most. The card should prove usable for creating business presentations and the like.

Aztech provides rudimentary business and media software in support of its card, including a basic mixer, simulated set of stereo components, Midisoft's Recording Session, and First Byte's Monologue for Windows (a text-to-speech program). You also get Aztech's Comvoice speech-recognition software, a .WAV file editor, and Aztech's CLEF OLE, an application that lets you embed sound into documents.

On paper, the Aztech WaveRider 32+ looks like a winner: wavetable synthesis, Sound Blaster and Microsoft Windows Sound System compatibility, decent software, and acceptable sound for just $199. But difficult installation and poor MIDI playback make it tough to recommend.

▶ **Aztech WaveRider 32+.** List price: *$199; SRS daughterboard, $39.* Aztech Labs Inc., *47811 Warm Springs Blvd., Fremont, CA 94539; 800-886-8854, 510-623-8988; fax, 510-623-8989.*

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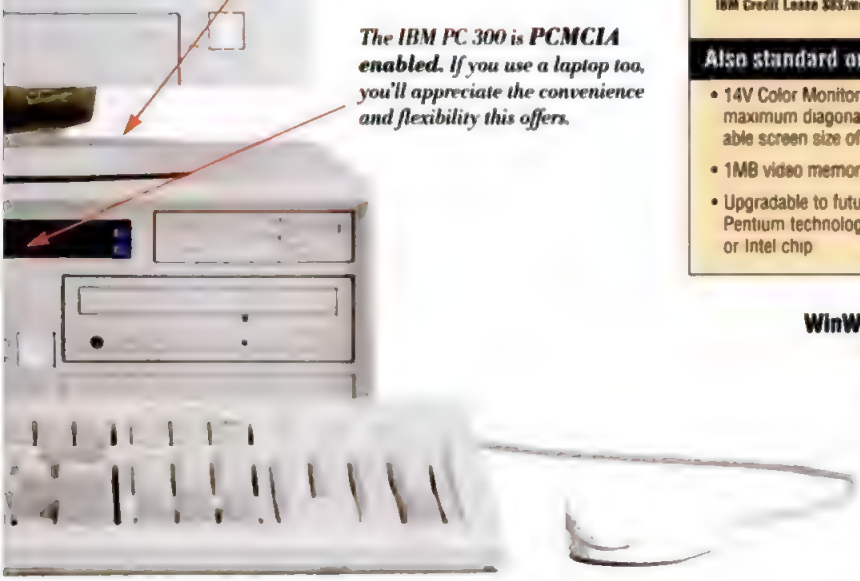

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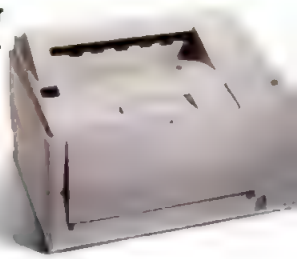

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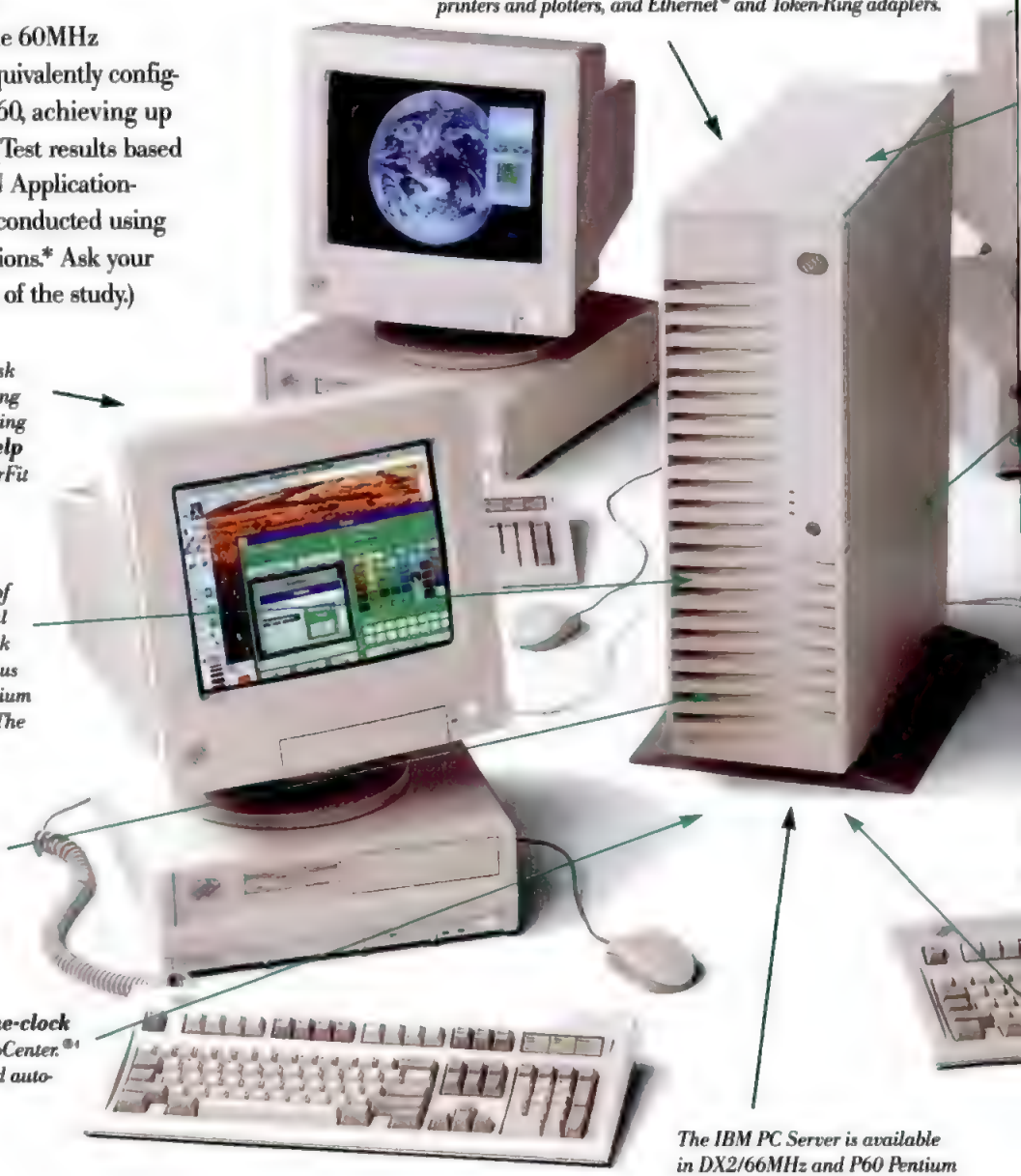

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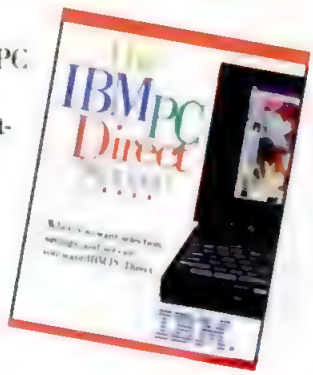

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Powered Speakers: *Just Listen*

By John R. Quain

Just as you wouldn't put bald tires on a brand new Ferrari, you shouldn't hook up $20 speakers to your new $250 sound board. Fortunately, there are plenty of external speakers designed to tap the full capabilities of the latest sound cards. We conducted subjective listening tests on 20 speaker systems from leading vendors with prices ranging from $19.95 to $699.00. We asked each vendor to send us examples from the midrange and high end of their product line. We found that there were acceptable models in most price ranges, but to find the speakers that meet your needs, you have to know what to look for.

First, most sound cards come with amplifiers that offer only 4 watts per channel or less and severely degrade sound quality. We strongly recommend that you purchase speakers that contain their own amplifiers and plug them directly into the stereo low-level line-out jack on your sound card. In general, a built-in amplifier that delivers 10 watts per channel is enough to fill the average office with Mozart or 7th Guest. Some of the more expensive (over $200) speakers we auditioned deliver 30 watts per channel, while those costing less than $30 tend to offer less than 2 watts per channel.

In addition to being self-powered, multimedia computer speakers should be magnetically shielded, so that their electromagnetic fields don't interfere with your monitor or hard disk. All the speakers we looked at include some form of magnetic shielding.

Lastly, desktop multimedia speakers should be small and deliver the best quality stereo sound when placed only a few feet apart and a few feet from the listener (such a setup is often referred to as a near-field design). All the models we reviewed are small enough to sit on a desk, and several three-piece designs include two stereo satellite speakers that sit on your desk and a lunch-box-size subwoofer that can be hidden under your desk. The satellite speakers reproduce high and midrange notes (from about 20 kHz down to 150 Hz); the subwoofer handles deeper bass notes (below 150 Hz).

Users with more than one PC on their desk or with an external MIDI instrument will appreciate the dual inputs several models include. A headphone jack that automatically mutes the speakers is also a handy feature. Also look for accessible power, volume, and tone controls.

HIGH-END CHOICES: The Acoustic Research Powered Partners 570, Altec Lansing ACS300.1, and Bose Acoustimass.

SPEAKERS OVER $200

In the "price is no object" category, we found several excellent multimedia speaker systems. Of the speakers we tested, the Acoustic Research Powered Partners 570 loudspeakers ($399 per pair) were the most impressive (International Jensen, 800-323-0707).

Each AR 570 contains its own 30-watt power amplifier, allowing the pair to be used in single monaural setups or hooked up to everything from a PC to an electric guitar. Housed in rugged but sleek alloy cases, both speakers have volume, bass, and treble controls up front. A power switch is located on the back of each speaker, but the system will turn off automatically after 60 seconds without input.

On our tests, the AR 570 speakers delivered the highest volume levels without unacceptable distortion. Their sound remained clean with good separation between instruments, sharp high notes, and tight bass response.

In contrast to the AR 570s, Altec Lansing Multimedia's $350 ($299 street) ACS300.1 system takes a more delicate approach (Altec Lansing Multimedia, Consumer Products Division, 800-258-3288, 717-296-4434). The speakers can handle two separate stereo sources and have an output jack for a set of headphones. On the front of the two clamshell-style satellite speakers are controls for power, volume, balance, treble, and bass. In concert with the supplied subwoofer, the 18-watt-per-channel speakers delivered smooth and accurate sound to please fastidious audiophiles. At the highest price level is Bose Systems' three-piece, $699 Acoustimass Multimedia Speaker System (Bose Systems, 800-444-2673). Unfortunately, the Acoustimass's controls for volume, treble, and bass are all awkwardly placed on the side of the subwoofer, making adjustments difficult. On the other hand, the Bose system's expansive sound quality makes music seem as if it is coming from all around you. Some listeners may find it warm and rich; others might feel it lacks definition and clarity. We found that with 20 watts of power for the satellites and 50 watts for the subwoofer, the Bose Acoustimass system was dominated by heavy bass.

The other speakers we looked at in this category were Panasonic's $249 EAB-710P Multimedia Speaker System (Panasonic Communications and Systems Co., 800-742-8086, 201-348-7000). Our tests found high distortion, muddy bass, and performance that in general did not compare well with the products discussed above.

SPEAKERS UNDER $200

The best offering in this category proved to be Altec Lansing's $150 ($119

street) ACS100.1 speakers. This pair of clamshell speakers is a smaller version of the ACS300.1, minus the subwoofer (you can plug them into Altec Lansing's $150 ACS150 or $129 ACS250 subwoofers for better bass). Volume, bass, and treble controls are all up front, and the internal power amp supplies 12 watts per channel. There's a headphone jack, inputs for two stereo sources, and a power button on the back. With or without the subwoofer, we found these to be generally very faithful speakers. Without the subwoofer, however, there is poorer bass response and a resultant tendency to overplay the high notes. Most of these problems can be compensated for by adjusting the treble and bass controls, however.

At $199, the Cambridge SoundWorks (Cambridge SoundWorks, 800-367-4434) is one of the most aurally faithful speaker systems in this review and a relative bargain. Direct speaker vendor Cambridge SoundWorks has a proven track record in consumer hi-fi speakers, and the SoundWorks we listened to did not disappoint. The three-piece system offers smooth sound reproduction comparable to several speakers in the over-$200 class. To get volume control you have to purchase a separate device for $12.95 from Cambridge SoundWorks. Make sure you do so, because without this extra piece of hardware the speakers will not easily be able to handle audio inputs such as a portable audio CD player. Also, when connected to a sound board with a variable output, they're likely to produce substantial distortion.

For those who want a simpler setup, the $179 AppleDesign Powered Speakers offer basic volume controls (Apple Computer, 800-538-9696, ext. 525). Astute listeners will notice that bass notes lack some fullness and high notes are somewhat truncated, but the AppleDesign speakers can deliver a smooth, pleasing sound at high volumes.

Yamaha's $149.95 YST-M10 speakers ($89 street price) are basic but reliable speakers. With power, volume, and presence (for treble adjustment) controls up front, the pair doesn't offer the multiple inputs, headphone jack, or sonic accuracy of Altec's ACS100.1, but they have a well-balanced sound that is easy to listen to. For $349, you can get the YST-SS1010 speakers, which are the YST-M10s with Yamaha's subwoofer to improve bass response. You can also buy the subwoofer separately as the YST-MSW10 for $199.95.

Aside from the standouts, there were several disappointing models in this price category. Though more expensive than the ACS100.1s, Altec's $180 ($149 street) ACS53 speakers did not measure up in sound quality. Labtec's $179.99 SB-8 Satellite/Subwoofer System (Labtec Enterprises, 206-896-2000) can easily be overdriven to distortion-producing levels. MIDI Land's $159 MLI-115 Multimedia Speaker System (MIDI Land Inc., 909-592-1168) and their identical $159 (estimated street price) Reveal RS380 counterparts (Reveal Computer Products, 800-326-2222) lacked lower bass and higher treble frequencies. We also found the sound quality of International Jensen's $149 JPS-45 disappointing (International Jensen, 800-323-0707). Sony's three-piece $199.95 SRS-D2KPC speaker system (Sony Electronics, 800-352-7669) inconveniently places controls on the subwoofer, and we found the sound dull compared to the Cambridge models. The "SRS" in the product name has nothing to do with the Sound Retrieval System for three-dimensional sound.

AFFORDABLE AND ACCEPTABLE: The Cambridge SoundWorks, AppleDesign Powered Speakers, and Altec Lansing ACS100.1.

SPEAKERS UNDER $100

Choosing speakers that cost less than $100 means sacrificing some flexibility and sonic clarity. And although there are speakers available for your PC that are under $50, most of these lower priced models produce poor sound.

Two notable choices we looked at are Panasonic's $99 EAB-401P Multimedia Speaker System and Koss's $99.99 HD-100 speakers (Koss Corp., 800-872-5677). Both models produce decent sound but suffer from sonic shortcomings typical of speakers in this price range. The bass response is weak, and boosting the volume will increase the amount of distortion. On the other hand, the Koss HD-100s are more adroit than most in this category, with microphone and headphone jacks included. MIDI Land's $79.95 MLI-65 did not measure up to other speakers in this price range.

Still less expensive speakers are available, but the sound produced by them was disappointing to say the least. Labtec's $59.95 LCS-600, MIDI Land's $19.95 MLI-168, and Koss's $29.99 HD-30 are all tiny stereo speakers for those who just want to get sound out of their PCs. None of these models includes a necessary power adapter or batteries. An adapter will usually cost you about $10 more.

PARTING ADVICE

In the end, because no single rating or specification will tell you how a speaker will sound to you, you have to go and listen to a few models yourself. Judging the quality of a speaker system can be highly subjective. To help you make your own decision, take along one or two of your favorite audio CDs (preferably one classical and one rock) to play over the speakers you're considering. Trust your ears, because what sounds best to you is what you'll be most happy with. □

Creative Labs Inc.

• Creative Labs Sound Blaster 16 Value Edition
• Creative Labs Sound Blaster AWE32 Value Edition
• Creative Labs Sound Blaster AWE32

BY ROB SCHENK

The Creative Labs Sound Blaster AWE32 ($399 list, $299 street) will satisfy music lovers, business audio users, and developers. The $329 Creative Labs Sound Blaster AWE32 Value Edition ($229 street), which lacks the upgradability of its sibling, is aimed at gamers and those on a stricter budget who don't need all the features of the full-blown AWE32. Performance and features rank these boards among the better midrange offerings in this roundup. The Creative Labs Sound Blaster 16 Value Edition ($139.95 list, $99 street) delivers solid audio performance for playing back games and edutainment titles.

SUITABILITY TO TASK

Sound Blaster 16 Value Edition

MIDI composition	FAIR
Business applications	GOOD
Multimedia authoring	FAIR
Games and edutainment	GOOD

The two AWE32 boards use the EMU-8000 processor for wavetable sounds, offering 32-voice polyphony through a 1MB wavetable. The Sound Blaster 16 offers FM synthesis only, with no wavetable option. Be aware that only CD-ROM drives with proprietary connectors from Sony, Mitsumi, and Creative Labs are supported; there is no standard IDE or SCSI connector on any of these boards. The two AWE32 cards feature Q-Sound technology, delivering 3-D spatial sound effects from titles that are encoded with Q-Sound. The boards also let you encode your own recordings with Q-Sound. The DOS-based installation routine made setup easy, especially with the extensive and well-illustrated documentation. Some jumper manipulation may be necessary should the default selections not suit you.

SUITABILITY TO TASK

Sound Blaster AWE32 Value Edition

MIDI composition	GOOD
Business applications	GOOD
Multimedia authoring	GOOD
Games and edutainment	GOOD

SUITABILITY TO TASK

Sound BlasterAWE32

MIDI composition	EXCELLENT
Business applications	EXCELLENT
Multimedia authoring	GOOD
Games and edutainment	GOOD

The AWE32 and AWE32 Value Edition produced above-average numbers on our Preamplifier tests. Digital playback performance was also above average. Indeed, the cards produced superior sound on games, with good bass and excellent treble response. MIDI playback was also impressive, with drums and piano that sounded crisp and realistic. Several patches (such as the harpsichord and certain strings) sounded a little synthetic, though, making these boards better suited for multimedia presentations than for serious recording.

The Sound Blaster 16 Value Edition showed good frequency response on our tests and solid Digital Playback scores. THD+N was slightly above our 0.1 percent threshold, but this should not present a problem for those looking to just play back prerecorded CD-ROM titles. Sound Blaster compatibility is a given with all these cards, but gamers should note that the cards use about 80K of conventional memory, which may make playing certain DOS games difficult because of memory limitations.

The AWE32 Value Edition and Sound Blaster 16 include good software utilities, including a .WAV file player, MIDI sequencer, and effect software. The full AWE32 also throws in scaled-down versions of Cakewalk Apprentice (a powerful MIDI sequencer) and HSC Interactive (a multimedia authoring program). Voice recognition software, text-to-speech software, and a microphone are also provided.

Both AWE32s are ideal for all but the most serious music recording. The Sound Blaster 16 Value Edition is good for entry-level users whose needs are not extravagant.

► **Creative Labs Sound Blaster 16 Value Edition.** List price: *$139.95.* **Creative Labs Sound Blaster AWE32 Value Edition.** List price: *$329.* **Creative Labs Sound Blaster AWE32.** List price: *$399.* Creative Labs Inc., *1901 McCarthy Blvd., Milpitas, CA 95035; 800-998-5227, 408-428-6600; fax, 408-428-6611.*

Circle 475 on reader service card

Ensoniq Corp.

• Ensoniq Soundscape

BY ROB SCHENK

Respectable wavetable sound quality, good bundled software, and a low price ($219 list) make the Ensoniq Soundscape a good choice for mainstream business and edutainment users. The sound quality isn't up to the standards of serious musicians and developers, but this board should satisfy most PC users.

The Soundscape uses Ensoniq's proprietary DSP chip, OTTO, which handles recording functions. The Soundscape also features an on-board 8-MHz Motorola 680EC000 processor, which helps reduce the strain on your system's CPU. Hardware support includes four labeled ports: CD/aux, line-out, mic/line-in, and a joystick/MIDI port. The board also has interfaces for Sony, Matsushita, and Mitsumi CD-ROM drives with proprietary connectors.

SUITABILITY TO TASK

Ensoniq Soundscape

MIDI composition	EXCELLENT
Business applications	GOOD
Multimedia authoring	GOOD
Games and edutainment	GOOD

Installation was straightforward using Ensoniq's own Windows-based routine. A fair number of jumpers are on the board, so some manipulation is necessary when changing I/O addresses and the like.

MIDI sound quality is good for a card in this price range. Playback of various audio files produced punchy percussives and warm sounding keys; guitars and several other strings sound a little artificial, though. Recording quality is good, with little distortion. The Soundscape had a good Frequency Response score and average THD+N and S/N Ratio results on the Digital Recording and Digital Playback tests.

With Version 1.2 of the Soundscape software, Ensoniq has fixed Sound Blaster emulation problems found when playing some DOS games. The board's only flaws here are some background noise and the lack of software effects for sound file editing. The Soundscape ships with a good selection of software, including AudioStation from Voyetra Technologies, which features a mixer, .WAV file editor, audio CD player, and a MIDI

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26. We were tempted to paint racing stripes on the side.
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46. My 486 is faster than yours! Neener neener neener!
47. It runs Lotus 1-2-3.
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51. 100MHz. Case closed.
52. Grease + lightning = 100MHz Am486.
53. Your 386 users will kiss you.
54. It's a smart move.
55. Runs WordPerfect.
56. Also WordPerfect Office.
57. And ClarisWorks, for that matter.
58. If you don't upgrade soon, your users will have you drawn and quartered.
59. Megahertz. 100 of them, to be exact.
60. We've invested over a billion dollars so we can keep cranking out tons of them.
61. Think you can pass up a deal this great?
62. You must be interested in high performance — you're still reading.
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67. It runs Harvard Graphics.
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90. It's like driving in the commuter lane, all the time.
91. It's an offer you can't refuse.
92. Even the folks with big budgets will admire your business sense.
93. It's the most appropriate technology for the bulk of your users.
94. You don't have to double check your math.
95. Compaq says, "100MHz 486 systems represent a significant market opportunity and we are delighted there will be an additional source of supply."— Jim Paschal, Vice President of Desktop and Corporate Engineering.
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Voice Mail for All

By Jae Yang

A developing breed of telephony add-in boards is giving new meaning to the term *business audio*. Combining sound and communications in one device, these cards offer features that home offices or small businesses can use to make callers think they've dialed into a large corporation. For example, the user can set up Touch-tone voice mail systems that let callers pick from a choice of departments. Some packages also let you create the same type of automated fax-back and prerecorded voice information services used by large technical-support departments.

For this sidebar, PC Magazine Labs tested three of the first products in this category: the Best Data ACE 5000 ($299; Best Data Products, 800-632-2378, 818-773-9600), the Boca SoundExpression 14.4VSp ($199; Boca Research, 407-997-6227), and the MediaMagic Telemetry-32 ($299; MediaMagic, 800-624-8654, 512-339-3500). We evaluated features, ease of use and installation, and sound quality for each product's fax receive, fax send, data receive, voice mail, call receive, and call out functions. We also ran some tests to see how well the cards could operate in the background while the user was working with another Windows-based application in the foreground. We were pleased to find that in all three cases we could edit, spell-check, and save Microsoft Word documents without any noticeable interruption or slowdown in performance. Since all three cards also include traditional sound card features, we tested them alongside our featured sound boards, and report the results in our Performance Tests section. Sound card features are compared with those of regular sound cards in our Summary of Features table.

BEST DATA ACE 5000

The Best Data ACE 5000 ($299) is based on an IBM Mwave DSP, which acts as both an audio coprocessor and a 14.4-Kbps voice modem. With an upgraded modem driver ($9), the ACE 5000 can speed up to 28.8 Kbps.

The included software, Version 1.04 of Smith Micro Software's Quick Link Message Center, provides an effective mailbox system that manages voice mail, faxes, fax-back, prerecorded information services, and message/fax forwarding. Message Center can also voice-page the recipients of calls by announcing them over attached powered speakers. Each mailbox is custom-configurable and password-protected, but there are only 10 mailboxes, compared with 1,000 each for the other two products. We also found the software's interface, which is divided into three parts, to be the least intuitive of the three products.

The MediaMagic Telemetry-32 has the most intuitive interface.

The sound quality of voice mail messages stored in a 4-bit proprietary format is the best of the three products, and the rate of data storage is on a par with others at 5 Kbps for voice. Faxes are stored in a proprietary file format.

BOCA SOUNDEXPRESSION 14.4VSP

Based on a dedicated Crystal Semiconductor chip set for sound and a Cirrus Logic chip set for its 14.4-Kbps fax modem, the SoundExpression comes with SoftNet Communications' FaxWorks Communications Center 3.00e to manage incoming calls and faxes. Its 1,000-mailbox capacity, comprehensive private fax-back (in which the caller punches in a password), and global fax-back features may seem overwhelming at first. But with some help from the well-written manual, the average user should be able to set up an impressive call management and information center within a day or two. SoundExpression can notify users of calls via fax or paging. Each mailbox is custom-configurable with its own notification method, outgoing message, dialing extension, and password. Voice mails and faxes can be forwarded to other mailboxes. All mail-

sequencer. Ensoniq also gives you Voyetra's OLE text-to-speech applet, as well as Verbex Voice Systems' voice recognition software.

Ensoniq offers the Soundscape with Altec Lansing ACS-31 speakers (which include a subwoofer) for $299. Around the time this goes to press, Ensoniq will release the Soundscape Elite ($279), which will offer real-time control of multiple sound effects. If your needs are not extravagant, the Soundscape is worth a look.

▶ **Ensoniq Soundscape.** List price: *$219.* Ensoniq Corp., *155 Great Valley Pkwy., Malvern, PA 19355; 800-776-8637, 610-647-3930; fax, 800-257-1439.*

Circle 476 on reader service card

Genoa Systems Corp.

Genoa AudioBlitz 3D

BY CHUL SUNG KIM

Genoa Systems Corp.'s Genoa AudioBlitz 3D delivers good sound at an attractive price. The $179 ($115 street) base model uses a Yamaha OPL3 chip for FM synthe-

box operations functioned properly in testing, but the speakers emitted a loud popping sound when the phone was being switched on or off. The sound was clear when using the speaker phone, but the voice mails and outgoing messages recorded in 4-bit ADPCM format, though audible, had the poorest sound of the three products. The recording rate of 5 Kbps translates to about 9MB for 30 minutes of voice mail.

One software glitch we found was that the fax-back feature skipped the first number when orally repeating a caller's telephone number for verification. Boca claims this will be fixed by the time you read this. Nevertheless, fax-backs were sent to the correct telephone numbers. Incoming faxes are stored as TIFFs.

MEDIAMAGIC TELEMETRY-32

The MediaMagic Telemetry-32 employs a 55-MHz AT&T DSP3207 for both sound and 19.2-Kbps modem functions. Syncro Development Corp.'s Multimedia Connect is included and is both the easiest to use and most bare-bones of the three products. Multimedia Connect's interface looks and functions so much like an actual speaker phone with an answering machine that the average user will not have to refer to the manual very much to program a voice mail system; keep in mind, however, there are none of the automated fax-back or automated message-on-demand features offered with the other two telephony cards. The sound quality of voice mail, which is recorded at the rate of 4 Kbps using 4-bit proprietary compression, is adequate. □

sis and is fine for entry-level gamers. For more sophisticated users, Genoa offers a Yamaha OPL4-equipped wavetable daughtercard ($99), which we also tested. The combination produces MIDI music typical of the OPL4: not outstanding but quite acceptable. With Sound Blaster compatibility and four CD-ROM drive interfaces—IDE and proprietary Mitsumi, Panasonic, and Sony—this affordable card is suited for games and multimedia apps.

The two-disk Windows-based installation utility is easy to use, and the well-illustrated manual takes you through installation step by step. Be aware, however, that we experienced bus-timing problems. On our test machine, an EISA Dell 450/ME with an Adaptec SCSI controller, the sound card was not recognized by its driver until we moved the cards closer to each other on the ISA bus.

On our performance tests, the AudioBlitz turned in numbers that were consistently above the median of the group and, in several cases, not far behind such star performers as the Turtle Beach Multi-Sound Monterey. Its THD+N and Frequency Response figures were particularly good, the latter being quite flat throughout most of the audible range with some attenuation at the highest frequencies. The AudioBlitz's amplifier also tested well but delivers only two watts per channel across 4 ohms—half its claimed output.

SUITABILITY TO TASK

Genoa AudioBlitz 3D	
MIDI composition	FAIR
Business applications	FAIR
Multimedia authoring	GOOD
Games and edutainment	GOOD

In subjective testing, the .WAV files we played sounded unremarkable though certainly free of noise and distortion. MIDI files sounded natural enough, but the instruments lacked true color. The MIDI playback is good for games and edutainment but not the best for music.

The AudioBlitz comes with just the basic software: Midisoft's Sound Impression, an audio rack (a mixer and .WAV file, MIDI, and audio CD players), a .WAV file recorder/editor, and Recording Session, Midisoft's MIDI sequencer. You won't find any business audio applications here. We weren't impressed by the wave editor; its interface is busy and confusing.

The AudioBlitz's good audio and decent MIDI performance should satisfy most mainstream sound card users. Considering the price, you shouldn't be disappointed.

► **Genoa AudioBlitz 3D.** List price: *$179; wavetable upgrade, $99.* Genoa Systems Corp., *75 E. Trimble Rd., San Jose, CA 95131; 800-943-3662, 408-432-9090; fax, 408-434-0997.*

Circle 477 on reader service card

KYE International Corp.

• KYE Genius SoundMaker 16E/Value Edition

BY CHUL SUNG KIM

KYE International Corp.'s KYE Genius SoundMaker 16E/Value Edition, at $99 list, is one of the lowest-priced sound cards we tested. The card offers FM synthesis only, with no wavetable option. But even at this price level, we found boards with markedly better sound.

Like most FM-synthesis cards, the SoundMaker's OPL3 synthesizer sounds artificial. Instruments largely lack the characteristic timbre of their real-world namesakes. String and wind instruments, for example, are barely distinguishable, and individual instruments are even less distinct. The mechanical sound isn't much of a problem for games with unrealistic sound effects anyway, but similarly priced boards get the job done better.

On our Digital Playback tests, the SoundMaker exhibited unusually high THD+N and quantization noise, and we detected slight hiss in 16-bit playback. Frequency response was also poor. The card's power amplifier displayed high THD+N on our tests, although its S/N ratio was good.

Unfortunately, the SoundMaker lacks a line-level output jack, and its external volume control works in the reverse of the usual fashion: You turn it *down* to increase the output level. The fact that the card uses jumpers to configure everything is another manifestation of KYE's low-cost approach; the majority of the cards in this roundup now feature software-configurable settings. KYE does include a Windows-based setup utility that makes installing the driver and applets easy. The board supports proprietary CD-ROM drives from Mitsumi, Panasonic, and Sony and has a MIDI/game port.

SUITABILITY TO TASK

KYE Genius SoundMaker 16E/Value Edition	
MIDI composition	POOR
Business applications	FAIR
Multimedia authoring	POOR
Games and edutainment	FAIR

KYE includes two CD-ROMs with the SoundMaker: Best Link Systems' MediaMate presentation software (the only concession to business use), an assortment of

▶ SUMMARY OF FEATURES

16-Bit Sound Boards

In alphabetical order by company
■ = YES □ = NO

	ACS LaserWave Nucleus 16	Adaptec AudioEdge	Adaptec SCSI AudioMachine	Advanced Gravis UltraSound Max	Antex Z1e	Aztech WaveRider 32+	Best Data ACE 5000	Boca Sound-Expression 14.4VSp
List price	$79.00	$249.00	$349.00	$249.00	$595.00	$199.00	$299.00	$199.00
General Features								
Maximum sampling rate (kHz)	44.1	44.1	44.1	48	48	48	44.1	44.1
Sound chip set	ESS 688F	Crystal Semi-conductor 4248	Crystal Semi-conductor 4248	ICS GF1	Crystal Semi-conductor 4216	Aztech AZT2316A	IBM Mwave	Crystal Semi-conductor 4231, Opti Media 929
Manufacturer of on-board DSP	N/A●	Analog Devices	Analog Devices	ICS	Texas Instruments	N/A●	IBM	N/A●
Amplifier (watts per channel)	4	4	4	4	N/A●	4	N/A●	4
IRQ levels supported	2, 5, 7, 10	2 or 9, 3, 5, 7, 10–12	2 or 9, 3, 5, 7, 10–12	2–5, 7, 9–11, 12, 15	2, 3, 5, 7, 10, 11	2, 5, 7, 10	3–5, 10, 11, 15	5, 7, 10, 11
Number of selectable addresses	4	4	4	6	4	2	2	4
User can set all IRQs and DMAs via software	□	□	□	■	□	■	□	□
Compatibility built into hardware or software:								
Ad Lib	Hardware	Hardware	Hardware	Software	Hardware	Hardware	N/A●	Both
Creative Labs Sound Blaster	Hardware	Hardware	Hardware	Software	N/A●	Hardware	Software	Both
Microsoft Windows Sound System	Both	Hardware	Hardware	Software	Software	Hardware	Software	N/A●
Roland MPU-401	N/A●	Hardware	Hardware	Software	Hardware	Hardware	N/A●	Hardware
Compression support built into hardware or software:								
ADPCM	Hardware	Software	Software	Hardware	Hardware	Hardware	Software	Hardware
A-Law	N/A●	N/A●	N/A●	Hardware	N/A●	Hardware	N/A●	Hardware
Mu-Law	N/A●	N/A●	N/A●	Hardware	N/A●	Hardware	N/A●	Hardware
MPEG compression	N/A●	N/A●	N/A●	N/A●	Hardware	N/A●	N/A●	N/A●
MPEG decompression	N/A●	N/A●	N/A●	N/A●	Hardware	Software	N/A●	N/A●
MIDI Synthesizer								
MIDI synthesizer chip	Yamaha OPL3	Analog Devices DSP 2115	Analog Devices DSP 2115	ICS GF1	Yamaha OPL3	ICS WaveFront, Yamaha OPL3	IBM Mwave	Yamaha OPL3
Synthesizer type	FM (wavetable option, $99)	FM, wavetable	FM, wavetable	Wavetable	FM (wavetable option, $195)	FM, wavetable	Wavetable	FM
Number of operators for FM synthesis	4	2	2	N/A●	4	4	N/A●	4
Provides MIDI interface/Supports General MIDI	■■	■■	■■	■■	■■	■■	□■	■■
Number of channels for recording/playback	16, 16	16, 16	16, 16	2, 34	16, 16	16, 16	2, 2	16, 16
Number of MIDI instruments provided	175	128	128	192	128	128	128	128
Storage location	Hard disk	On-board ROM	On-board ROM	Hard disk	On-board ROM	On-board ROM	Hard disk	Hard disk
Number of simultaneously supported instruments	20	32	32	32	16	32	8	20
Number of voices	20	32	32	32	20	32	8	20
3-D sound technology	None	None	None	None	None	Optional SRS, $39	None	None
Mixing Capabilities								
Mixes audio from:								
CDs/Microphone	■■	■■	■■	■■	■■	■■	■■	■■
PC internal speaker/Stereo DAC	■■	□□	□□	□■	□■	■■	■■	□■
Stereo line-in/Stereo synthesizer	■■	■■	■■	■■	■■	■■	■■	■■
Connectors and Ports								
CD-ROM drive interfaces	Proprietary Mitsumi, Panasonic, Sony; optional SCSI connector, $29	SCSI-2	SCSI-2	Proprietary Mitsumi, Panasonic, Sony	SCSI-1	IDE; proprietary Mitsumi, Panasonic, Sony	Proprietary Panasonic, TEAC SuperQuad 4X	IDE; proprietary Mitsumi, Panasonic, Sony
Joystick/Variable line-out	■■	■■	■■	■■	■□	■■	□□	■■
Microphone/Low-level line-out	■■	■■	■■	■■	■□	■■	■■	■■
Low-level line-in	■	■	■	■	■	■	■	■
Technical Support								
Toll-free technical support	■	■	■	□	■	■	□	□
Technical-support hours (eastern time)	12:00–8:00 M–F	9:00–8:00 M–F	9:00–8:00 M–F	11:00–7:30 M–F	12:00–8:00 M–F	11:00–8:00 M–F	8:00–4:30 M–F	8:00–6:30 M–F
Warranty	2 years	5 years	5 years	3 years	1 year	1 year	2 years	5 years

N/A●—Not applicable. The product does not have this feature.

CONTINUES

	Creative Labs Sound Blaster 16 Value Edition	Creative Labs Sound Blaster AWE32 Value Edition	Creative Labs Sound Blaster AWE32	Ensoniq Soundscape	Genoa AudioBlitz 3D	KYE Genius SoundMaker 16E/Value Edition	Logitech SoundMan Wave	MediaMagic Telemetry-32	Mediatrix Audiotrix Pro
	$139.95	$329.00	$399.00	$219.00	$179.00	$99.95	$249.00	$299.00	$295.00
	44.1	44.1	44.1	44.1	48	44.1	44.1	44.1	48
	Proprietary Creative Labs	E-mu 8000	E-mu 8000	Ensoniq OTTO	Opti Media 929	ESS 688F	Media Vision Jazz 16	AT&T 3210	Crystal Semiconductor 4231
	Creative Labs	E-mu	E-mu	N/A[1]	N/A[1]	N/A[1]	N/A[1]	AT&T	Crystal Semiconductor
	4	4	4	N/A[1]	4	2	4	4	4
	2, 5, 7, 10	2, 5, 7, 10	2, 5, 7, 10	2, 5, 7, 10	5, 7, 11	5, 7, 9, 10	2, 3, 5, 7, 10, 15	5, 7, 9–11, 15	7, 9–11
	4	4	4	5	2	4	4	4	4
	☐	☐	☐	☐	☐	☐	■	■	■
	Hardware	Hardware	Hardware	Both	Both	Hardware	Hardware	Both	Hardware
	Hardware	Hardware	Hardware	Both	Both	Hardware	Hardware	Software	Hardware
	N/A[1]	N/A[1]	N/A[1]	Both	N/A[1]	N/A[1]	N/A[1]	Software	Hardware
	Hardware	Hardware	Hardware	Both	Both	N/A[1]	Hardware	Hardware	Hardware
	Software	Software	Hardware	Software	Software	Hardware	Hardware	Software	Hardware
	Software	Software	Hardware	Hardware	Software	N/A[1]	Hardware	Software	Hardware
	Software	Software	Hardware	Hardware	Software	N/A[1]	Hardware	Software	Hardware
	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	Software	N/A[1]
	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	N/A[1]	Software	N/A[1]
	Yamaha OPL3	E-mu 8000, Yamaha OPL3	E-mu 8000, Yamaha OPL3	Ensoniq OTTO	Yamaha OPL3	Yamaha OPL3	Yamaha OPL4	AT&T 3210	Yamaha OPL4
	FM	FM, wavetable	FM, wavetable (wavetable upgrade $249)	FM, wavetable	FM, wavetable option, $99)	FM	FM, wavetable	FM, wavetable	FM, wavetable
	4	4	4	4	4	4	4	4	4
	■■	■■	■■	■■	■■	■■	■■	■■	■■
	16, 16	16, 16	16, 16	16, 16	2, 2	4, 4	5, 5	10, 10	32, 32
	128	128	128	128	128	128	128	128	128
	Hard disk	On-board ROM	On-board ROM	On-board ROM	Hard disk	On-board ROM	On-board ROM	On-board ROM	On-board ROM
	20	16	16	16	20	4	20	24	32
	20	32	32	32	20	16	44	20	44
	None	Q-Sound	Q-Sound	None	SRS	None	None	None	Optional SRS, $90
	■■	■■	■■	■■	■■	■■	■■	■■	■■
	■■	■■	■■	☐■	■■	☐■	■■	☐☐	☐☐
	■■	■■	■■	■■	■■	■■	■■	■■	■■
	Proprietary Panasonic	Proprietary Mitsumi Panasonic Sony	Proprietary Mitsumi Panasonic Sony	Proprietary Mitsumi Panasonic Sony	IDE proprietary Mitsumi Panasonic Sony	Proprietary Mitsumi Panasonic Sony	Proprietary SCSI	IDE proprietary Mitsumi Panasonic Sony	Optional connectors: proprietary Mitsumi Panasonic, Sony, $30; SCSI-2, $48; Philips CM206, $55
	■■	■■	■■	■☐	■■	■■	■■	■■	■■
	■■	■■	■■	☐■	■■	■■	■■	■■	■■
	■	■	■	■	■	■	■	■	■
	☐	☐	☐	☐	☐	☐	☐	■	☐
	9:00 A.M.–1 A.M. 7 days	9:00 A.M.–1 A.M. 7 days	9:00 A.M.–1 A.M. 7 days	8:30–5:30 M–F	11:00–8:00 M–F	8:00–5:00 M–F	24 hours, 7 days	7:00 A.M.–1:00 A.M. M–F	9:00–5:00 M–F
	1 year	1 year	1 year	3 years	2 years	1 year	3 years	1 year	1 year

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– PC Magazine
December 20, 1994

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SUMMARY OF FEATURES

16-Bit Sound Boards

In alphabetical order by company ■ = YES □ = NO	Media Vision Premium 3-D	Media Vision Pro 3-D	miroSound PCM 1 PRO	Multiwave Audiowave Green 16	New Media .WAVjammer	Orchid SoundWave 32 Pro SCSI	Orchid SoundWave 32+ Studio	Reveal SoundFX
List price	$199.00	$379.00	$229.00	$99.00	$399.00	$279.00	$399.00	$69.99
General Features								
Maximum sampling rate (kHz)	48	48	44.1	44.1	44.1	48	48	44.1
Sound chip set	Media Vision MVD1216	Media Vision MVD1216	Crystal Semiconductor 4231	ESS 688F	Crystal Semiconductor 4248	Analog Devices DSP 2115	Analog Devices DSP 2115	Reveal proprietary
Manufacturer of on-board DSP	N/A●	N/A●	N/A●	N/A●	N/A●	Analog Devices	Analog Devices	N/A●
Amplifier (watts per channel)	1–4	1–4	4	4	N/A●	4	4	4
IRQ levels supported	1, 3, 5, 7, 11, 15	1, 3, 5, 7, 11, 15	7, 9–11	2, 5, 7, 10	0–15	3–5, 7, 9–12	3–5, 7, 9–12	2, 5, 7, 9, 11, 15
Number of selectable addresses	6	6	4	4	N/A●	8	8	2
User can set all IRQs and DMAs via software	■	■	■	□	■	■	■	■
Compatibility built into hardware or software								
Ad Lib	Software	Software	Hardware	Hardware	Software	Both	Both	Both
Creative Labs Sound Blaster	Software	Software	Hardware	Hardware	N/A●	Hardware	Hardware	Both
Microsoft Windows Sound System	Software	Software	Hardware	Both	Software	Hardware	Hardware	Both
Roland MPU-401	Software	Software	Software	N/A●	N/A●	Both	Both	N/A●
Compression support built into hardware or software								
ADPCM	Hardware	Hardware	Hardware	Hardware	Both	Both	Both	Hardware
A-Law	Hardware	Hardware	Hardware	N/A●	Both	Hardware	Hardware	Hardware
Mu-Law	Hardware	Hardware	Hardware	N/A●	Both	Hardware	Hardware	Hardware
MPEG compression	N/A●	N/A●	N/A●	N/A●	N/A●	N/A●	N/A●	N/A●
MPEG decompression	N/A●	N/A●	N/A●	N/A●	N/A●	N/A●	N/A●	N/A●
MIDI Synthesizer								
MIDI synthesizer chip	Yamaha OPL3	Korg wavetable, Yamaha OPL3	Yamaha OPL4	Yamaha OPL3	Yamaha OPL3	Analog Devices DSP 2115	Analog Devices DSP 2115	Reveal proprietary
Synthesizer type	FM (wavetable option, $199)	FM, wavetable	FM, wavetable	FM (wavetable option, $79)	FM	FM, wavetable (wavetable upgrade, $129–$219)	FM, wavetable	FM
Number of operators for FM synthesis	4	4	4	4	4	8	2	4
Provides MIDI interface/Supports General MIDI	■■	■■	■■	■■	□■	■■	■■	■□
Number of channels for recording/playback	16, 16	16, 16	32, 32	16, 16	6, 6	16, 16	16, 16	4, 4
Number of MIDI instruments provided	128	128	128	175	128	208	722	128
Storage location	On-board ROM	On-board ROM	On-board ROM	Hard disk	On-board ROM	On-board ROM	On-board ROM	On-board ROM
Number of simultaneously supported instruments	20	20	32	20	20	16	32	4
Number of voices	20	32	44	20	20	32	56	20
3-D sound technology	SRS	SRS	None	None	None	Q-Sound	Q-Sound	None
Mixing Capabilities								
Mixes audio from								
CDs/Microphone	■■	■■	■■	■■	■■	■■	■■	■■
PC internal speaker/Stereo DAC	□□	□□	■■	■■	□■	□□	□□	■■
Stereo line-in/Stereo synthesizer	■■	■■	■■	■■	■□	■■	■■	■■
Connectors and Ports								
CD-ROM drive interfaces	SCSI-2; proprietary Mitsumi, Panasonic, Sony	SCSI-2	IDE, proprietary Mitsumi, Panasonic, Sony	Proprietary Mitsumi, Panasonic, Sony; optional SCSI connector, $25	None	SCSI, proprietary Mitsumi	SCSI, proprietary Mitsumi	Proprietary Mitsumi, Panasonic, Sony
Joystick/Variable line-out	■■	■■	■■	■■	□□	■■	■■	■■
Microphone/Low-level line-out	■■	■■	■■	■■	■■	■■	■■	■■
Low-level line-in	■	■	■	■	■	■	■	■
Technical Support								
Toll-free technical support	■	■	□	□	□	□	□	■
Technical-support hours (eastern time)	9:00–11:00 M–F, 11:00–7:00 Sat–Sun.	9:00–11:00 M–F, 11:00–7:00 Sat–Sun	10:00–9:00 M–F	10:00–9:00 M–F	9:00–9:00 M–F	10:00–8:00 M–F	10:00–8:00 M–F	24 hours, 7 days
Warranty	3 years	3 years	2 years	1 year	Lifetime	4 years	4 years	1 year

N/A● —Not applicable. The product does not have this feature. N/A● —Not applicable. This board emulates DMA channels through its device driver.

ENDS

	Reveal SoundFX Wave	Turtle Beach Monte Carlo	Turtle Beach Tropez	Turtle Beach MultiSound Monterey
	$160.00	$149.00	$249.00	$399.00
	44.1	44.1	48	44.1
	Reveal proprietary	Crystal Semiconductor 4231	Crystal Semiconductor 4231	Turtle Beach proprietary
	N/A[1]	N/A[1]	N/A[1]	Motorola
	N/A[1]	4	N/A[1]	N/A[1]
	2, 5, 7, 9–11	2, 5, 7, 9, 11	2, 5, 9–12, 15	5, 7, 9–12, 15
	4	II	5	6
	■	■	■	■
	Both	Hardware	Hardware	N/A[1]
	Both	Hardware	Hardware	N/A[1]
	Both	Hardware	Hardware	Hardware
	Both	N/A[1]	Hardware	N/A[1]
	Hardware	Hardware	Hardware	Hardware
	Hardware	Hardware	Hardware	N/A[1]
	Hardware	Hardware	Hardware	N/A[1]
	N/A[1]	N/A[1]	N/A[1]	N/A[1]
	N/A[1]	N/A[1]	N/A[1]	N/A[1]
	Reveal proprietary	Yamaha OPL3	ICS WaveFront, Yamaha OPL3	ICS WaveFront
	FM, wavetable	FM	FM, wavetable	Wavetable
	4	4	4	N/A[1]
	■■	■■	■■	■■
	4, 4	16, 32	32, 48	16, 48
	228	128	128	128
	On-board ROM	Hard disk	On-board ROM	On-board ROM
	24	32	32	32
	24	32	32	32
	None	None	None	None
	■■	■■	■■	■■
	■■	□■	□■	□■
	■■	■■	■■	■■
	IDE proprietary Mitsumi Panasonic Sony	Proprietary Mitsumi Panasonic Sony	IDE	None
	■□	■■	■□	□□
	■■	■■	■■	□■
	■	■	■	■
	■	□	□	□
	24 hours, 7 days	9:00–6:00 M–F	9:00–6:00 M–F	9:00–6:00 M–F
	1 year	1 year	1 year	1 year

media clips, a caching CD-ROM driver, and PhotoCD tools. A mixer panel, a .WAV file editor, and an audio clip library are accompanied by several "talking" applets: a talking clock, calculator, reminder, stopwatch, and timer. These cute additions don't make up for the absence of MIDI sequencing software.

With this inexpensive board, you get what you pay for. Our advice is to spend the extra money and get a card that offers more useful applications, easier installation, and better sound.

▶ **KYE Genius SoundMaker 16E/Value Edition.** List price: *$99.* KYE International Corp., *2605 E. Cedar St., Ontario, CA 91761-8511; 909-923-3510; fax, 909-923-3510.*

Circle 478 on reader service card

Logitech Inc.

• Logitech SoundMan Wave

BY CHUL SUNG KIM

Known for its mice and trackballs, Logitech is branching out with a complete family of input and output devices. The newest audio offering is the $249 Logitech SoundMan Wave ($99 to $129 street). Featuring a SCSI interface, acceptable Yamaha OPL4 wavetable synthesis, and a strong collection of apps, the SoundMan Wave is a good bet for business and home users looking for a complete and affordable entry into multimedia.

One of the first things you'll notice about the Logitech board is that it's almost jumper-free. Except for joystick-port enabling, all settings are software-configurable. In another nice touch, the SoundMan Wave's installation utility tests your address, interrupt, and DMA selections for conflicts and plays music to let you know the card is working. A SCSI port and a CD audio connector are on-board, but you'll have to buy the cables separately.

SUITABILITY TO TASK	Logitech SoundMan Wave
MIDI composition	GOOD
Business applications	GOOD
Multimedia authoring	FAIR
Games and edutainment	GOOD

The Yamaha OPL4 synthesizer and wavetable ROM produce decent MIDI sound. Pianos and drums are fairly convincing, although their sound envelope is somewhat abbreviated. The violin and other string instruments display at least a semblance of authentic timbre. The brass section could definitely stand improvement. Still, the sound produced should be fine for most games and multimedia titles.

The SoundMan Wave's digital audio fidelity is somewhat spotty. Its preamplifier frequency response curve is quite flat, showing only slight dropoff between 20 Hz and 20 kHz. Channel separation is also good. Its S/N ratio, on the other hand, was higher than the group median. Matters worsened on the Digital Playback tests, where the SoundMan Wave's THD+N and Quantization Noise figures were among the worst in this roundup.

The card comes with a respectable array of software. Midisoft's Recording Session and a well-designed audio rack (Animotion Development Corp.'s MCS MusicRack) handle the most important functions. Extras include Berkeley Speech Technologies' BeSTspeech ReadOUT text-to-speech utility and Voyetra Technologies' SoundMan Annotator (an OLE-compliant voice-annotation utility).

The sound quality isn't top-notch, but the SoundMan Wave is still a good value for mainstream business and edutainment users.

▶ **Logitech SoundMan Wave.** List price: *$249.* Logitech Inc., *6505 Kaiser Dr., Fremont, CA 94555; 800-231-7717, 510-795-8500; fax, 510-792-8901.*

Circle 479 on reader service card

Mediatrix Peripherals Inc.

• Mediatrix Audiotrix Pro

BY ROB SCHENK

The Mediatrix Audiotrix Pro ($299 list, $225 street) from Mediatrix Peripherals provides a lot of bang for the buck. Above-average sound quality, a wealth of bundled software, and various upgrade options make the board easy to recommend. The package has some rough edges, but it will still satisfy MIDI lovers, game players, business users, and higher-end audio users and developers on a budget.

The Audiotrix Pro features Mediatrix's implementation of the Yamaha OPL4 chip set and supports SCSI CD-ROM drives and proprietary drives from Mitsumi, Panasonic, and Sony. Installation of the board was painless (both DOS and Win-

SUITABILITY TO TASK Mediatrix Audiotrix Pro	
MIDI composition	GOOD
Business applications	GOOD
Multimedia authoring	GOOD
Games and edutainment	EXCELLENT

dows installation utilities are included), and the card has no jumpers; IRQs and DMAs are both software-addressable.

The Audiotrix Pro performed well on our sound tests. The card's preamplifier is top-notch. Results on our Digital Recording tests were also excellent; its only flaw is a Channel Separation score of -67 dBr on the Preamplifier tests, which will make creation of a completely crisp stereo image difficult. MIDI lovers and game users will be impressed by the quality of the board's wavetable sound. Percussives are punchy and crisp, while keyboards are realistic and convincing. For even better sound quality, Mediatrix offers a $90 effects processor that adds SRS's three-dimensional sound system. You can also add an $85 RAM/ROM expansion board for storing customized wavetables.

Mediatrix gives you a generous array of bundled software, including an audio CD player, Midisoft's Music Magic MIDI sequencer, and a voice annotator with OLE support. A karaoke program (Tune 1000 Corp.'s Soft Karaoke) is thrown in so you can torture friends with your vocal prowess. The Audiotrix Pro also ships with a pair of low-end Hi-Tex 55 speakers.

There are still areas for improvement. We noticed buggy communication between Midisoft's Sound Impression mixer and the Mediatrix mixer, though the company reports the problem has since been fixed. Documentation was sparse for the sound card and nonexistent for the bundled third-party software. If you can forgive these shortcomings, the Audiotrix Pro delivers impressive sound quality and features for a board at this price.

► **Mediatrix Audiotrix Pro.** List price: *$295; Mitsumi, Panasonic, and Sony CD-ROM drive interface, $30; Philips CM206 CD-ROM interface, $55; SCSI-2 CD-ROM drive interface, $48.* Mediatrix Peripherals Inc., *4229 Garlock St., Sherbrooke, Quebec J1L2C8, Canada; 800-820-8749, 819-829-8749; fax, 819-829-5100.*

Circle 480 on reader service card

Media Vision Inc.

• Media Vision Premium 3-D
• Media Vision Pro 3-D

BY JAE YANG

With flamboyant features, including three-dimensional "surround sound" audio and a 32-voice polyphonic wavetable synthesizer, the Media Vision Pro 3-D ($379 list) will attract edutainment users and game addicts. The FM-synthesis Media Vision Premium 3-D ($199 list) lets you experience 3-D sound now and add the fine wavetable synthesis later. Media Vision's wavetable MIDI is among the best around, but the less-than-excellent audio quality we saw from these boards will leave multimedia authors wanting.

SUITABILITY TO TASK Media Vision Premium 3-D	
MIDI composition	GOOD
Business applications	GOOD
Multimedia authoring	FAIR
Games and edutainment	GOOD

The entry-level Premium 3-D delivers Yamaha's OPL3 FM synthesizer and is upgradable to wavetable synthesis by adding Media Vision's Wave Blaster–compatible daughtercard ($199). The Pro 3-D package is the identical card with the daughtercard bundled in. The Premium 3-D comes in two variations for connecting CD-ROM drives: SCSI and proprietary connectors for Mitsumi, Panasonic, and Sony drives. The Pro 3-D is SCSI-only. Installing the cards, even in a system loaded with a network card and a SCSI controller, was a breeze. Choosing the auto-installation option allows the software to test the system resources automatically and make appropriate adjustments to the card's IRQ, DMA, and base address settings. The documentation was thorough and informative.

SUITABILITY TO TASK Media Vision Pro 3-D	
MIDI composition	EXCELLENT
Business applications	GOOD
Multimedia authoring	FAIR
Games and edutainment	EXCELLENT

The cards' three-dimensional effects, employing SRS's Sound Retrieval System (SRS) technology, certainly added another dimension to the listening experience. Press the SRS button and you are suddenly surrounded by a fuller, more substantial stereo field. Unfortunately, because of the additional circuitry you'll also notice amplified high-frequency hiss, much like when you turn off Dolby noise reduction on your stereo system.

Even without SRS engaged, our tests showed the cards to have below-average S/N ratios and undesirably high THD+N, especially in digital playback. Frequency response on both our Digital Playback and Preamplifier tests was very good, though. The sound quality is good enough for most multimedia applications—business presentations, games, CD-ROM playback—but not so for those involved in multimedia authoring and high-end audio work.

The FM-synthesis MIDI of the base Premium 3-D is unspectacular, and most users will want to upgrade to wavetable or opt for the Pro 3-D right off the bat. Media Vision's Professional Wavetable Upgrade card is compatible with the Wave Blaster and is one of the best implementations in this roundup. The Korg synthesizer module produces lively and colorful sound, with authentic patches stored in 4MB of ROM.

The Midisoft Sound Impression that ships with the boards provides a mixer, waveform recorder, MIDI player, and audio CD player. The packages also includes Dragon Systems' Talk-To Plus voice control software, FirstByte's Monologue for Windows text-to-speech software, and a microphone. Considering the neat 3-D effects, easy installation, and great optional wavetable MIDI sound, gamers and edutainment users should thoroughly enjoy the Media Vision cards.

► **Media Vision Premium 3-D.** List price: *$199.* **Media Vision Pro 3-D.** List price: *$379.* Media Vision Inc., *47900 Bayside Pkwy., Fremont, CA 94538; 800-845-5870, 510-770-8600; fax, 510-770-8648.*

Circle 481 on reader service card

miro Computer Products Inc.

• miroSound PCM 1 PRO

BY ROB SCHENK

The $229 miroSound PCM 1 PRO ($199 street) is miro Computer Products' first entry into the sound board market. Targeted at MIDI users, gamers, and business audio users, the miroSound offers good sound at a competitive price.

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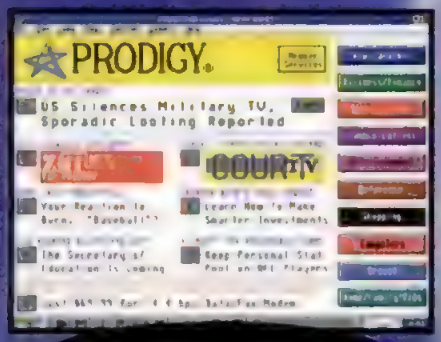

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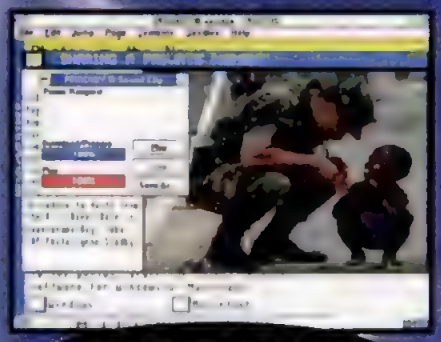

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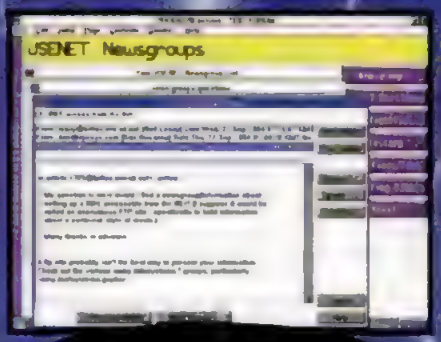

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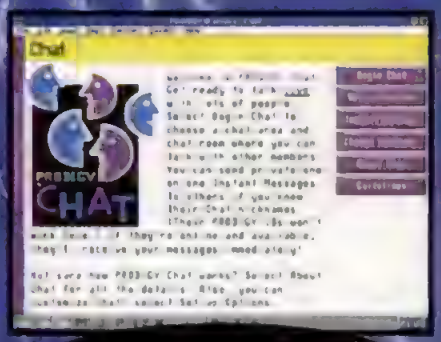

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The board utilizes Yamaha's OPL4 wavetable chip set and is backward-compatible to OPL3 through software emulation. The board has five labeled ports: amp/line-out, joystick/MIDI, line-in, monaural mic, and a 9-pin port for a MIDI expansion box. Standard IDE CD-ROM drives are supported, as are proprietary interfaces from Mitsumi, Panasonic, and Sony. Installation was simple enough, but if you run into a resource conflict (as we did with our Adaptec SCSI adapter), you have to diagnose the problem yourself and change the settings manually. Other boards we reviewed now handle this for you through software. Documentation for the board was adequate, but could use an index.

SUITABILITY TO TASK miroSound PCM 1 Pro	
MIDI composition	GOOD
Business applications	GOOD
Multimedia authoring	GOOD
Games and edutainment	GOOD

The miroSound was one of the most noise-free cards we tested, achieving an impressive 85 dBr S/N ratio. On our Digital Playback tests, there was a slight loss of bass notes below 100 Hz, although other numbers were above average. The power amp, however, needs some work: The card is not capable of delivering clean sound above 0.5 watts (you'll want to use your own powered speakers).

Sound from the board was crisp and clean—more than adequate for business applications, games, and most CD titles. The Yamaha wavetable produced good MIDI playback in general; drums and piano are realistic, although some strings sound a little artificial.

The package ships with several applications, including Sonic Foundry's Sound Forge, a sound editing and effects package; Dynaware USA's Ballade Lite, a MIDI sequencer and notation application; and Ulead Systems' HQ 9000, a media rack that includes an audio CD player, sound mixer, and .WAV file player. A proprietary seven-channel stereo mixer is also bundled. Business users will have to purchase business-audio apps separately.

With the miroSound PCM 1 PRO, the company has made a respectable debut into the sound card market. A complete software-based installation would be welcome, but for the price, the miroSound offers solid wavetable sound quality that should suit all but high-end users.

▶ **miroSound PCM 1 PRO.** List price: *$229.* miro Computer Products Inc., *955 Commercial St., Palo Alto, CA 94303; 800-249-6476, 415-855-0940; fax, 415-855-9004.*

Circle 482 on reader service card

New Media Corp.

• New Media .WAVjammer

BY BENJAMIN F. MILLER

For notebook computer users who need a lot of sound in a little space, New Media Corp. offers its New Media .WAVjammer 16-bit PCMCIA sound card. The $399 bundle ($269 street), which includes a copy of Microsoft Windows Sound System, is aimed squarely at business users who need sound on the road, particularly for presentations. Voice and sound effects are the card's strong suit. Its FM synthesis is passable for educational titles and games when work is done, though the .WAVjammer is not Sound Blaster–compatible.

The card does not provide SCSI or any other CD-ROM connections. It does ship with a portable microphone and a dongle with microphone inputs, line inputs, and a headphone/speaker jack. Installation took just a matter of minutes. New Media provides SystemSoft's card and socket services, which recognized the card immediately. The .WAVjammer is also compatible with the Intel/Microsoft Plug and Play specification for PCMCIA devices.

SUITABILITY TO TASK New Media .WAVjammer	
MIDI composition	POOR
Business applications	EXCELLENT
Multimedia authoring	POOR
Games and edutainment	FAIR

The .WAVjammer turned in mixed performance on our tests. Preamplifier THD+N was a low 0.01 percent. It also had the best Quantization Noise score on our Digital Recording tests. If you needed to fix a presentation on the road, sound quality from the card would suffice. Our Frequency Response tests, however, showed some drop in signal strength above 1 kHz. In subjective testing we did notice that, while music files played well enough, they lost a little strength at the high end of the spectrum. Voice and sound effects files played clearly and realistically on the .WAVjammer; MIDI files sounded synthetic.

Microsoft Windows Sound System provides a broad range of business audio tools. It features basic mixers, an audio CD player, an OLE-capable recorder, and a voice-command program, Voice Pilot. ProofReader, a text-to-speech program, rounds out the set. Also handy is the Sound Finder program for cataloging and easily locating .WAV files on your PC.

Though the .WAVjammer has excellent audio characteristics, you might expect wavetable synthesis and better MIDI reproduction for the money. Alas, getting a sound card into this small design has its price. If your career hinges on presentations on the road, the .WAVjammer delivers most of the goods.

▶ **New Media .WAVjammer.** List price: *$399.* New Media Corp., *1 Technology, Bldg. A, Irvine, CA 92718; 800-227-3748, 714-453-0100; fax, 714-453-0114.*

Circle 483 on reader service card

Orchid Technology

• Orchid SoundWave 32 Pro SCSI
• Orchid SoundWave 32+ Studio

BY BENJAMIN F. MILLER

With the Orchid SoundWave 32 Pro SCSI ($279 list, $210 street) and the Orchid SoundWave 32+ Studio ($399 list, $290 to $320 street), Orchid Technology has targeted gamers, edutainment users, and MIDI enthusiasts. Orchid has revamped its offerings since we last visited its products, greatly improving both the installation procedure and sound quality. Indeed, these wavetable-equipped boards deliver audio that is pleasing to the ear and software utilities that are useful and well-implemented.

Orchid's Windows-hosted installation program is unbelievably easy to use. You can change sound card configurations on the fly (no need to reboot your PC), and the cards' drivers have to be executed only once (either manually or in AUTOEXEC .BAT) and take up no memory in DOS.

The more expensive Studio is aimed squarely at MIDI enthusiasts. It delivers a total of 6MB of samples (versus the Pro

SCSI's 2MB) in its *two* wavetable MIDI synthesizers; the main synthesizer is from Euphonics, the second from Crystal/ Dream. This arrangement delivers more polyphony—up to 56 simultaneous voices instead of 32—as well as built-in effects like reverb, chorus, flanging, echo, and delay. For the more casual game and edutainment user, the Pro SCSI's standard wavetable should satisfy.

SUITABILITY TO TASK Orchid SoundWave 32 Pro SCSI	
MIDI composition	FAIR
Business applications	GOOD
Multimedia authoring	GOOD
Games and edutainment	EXCELLENT

On our objective performance tests, the cards' frequency response curves were close to ideal flatness through the entire audio range. THD+N and S/N Ratio figures placed them in the middle of the pack. On subjective tests, both Orchid cards produced clear and full sound with distinct voices while playing .WAV files. Both are also Sound Blaster–compatible and produced music and sound effects from DOS games with distinction. The Studio, especially, delivered strong MIDI playback with well-defined voices and dynamic transitions from loud to soft passages.

SUITABILITY TO TASK Orchid SoundWave 32+ Studio	
MIDI composition	GOOD
Business applications	GOOD
Multimedia authoring	GOOD
Games and edutainment	GOOD

Orchid's graphical Media Rack includes an audio CD player, MIDI player, .WAV file player/recorder, and a mixer. The mixer has three different displays (for playback, recording, and microphone); changing between them is as easy as clicking the mouse. Orchid's mixer also includes six presets that let you store preferences for different audio uses. Both the .WAV file player and the MIDI player include character displays that indicate the file being played.

Orchid's cards deliver the sound quality and feature set most wide-eyed gamers or edutainment users want. If your audio work involves MIDI, you will probably want to consider the Studio.

▶ **Orchid SoundWave 32 Pro SCSI.** List price: *$299.* **Orchid SoundWave 32+ Studio.** List price: *$349.* Orchid Technology, *45365 Northport Loop West, Fremont, CA 94538; 800-767-2443, 510-683-0300; fax, 510-490-9312.*

Circle 484 on reader service card

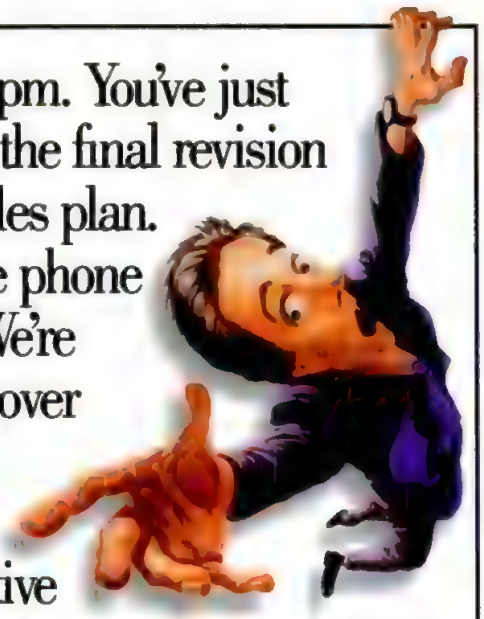
Reveal Computer Products

• Reveal SoundFX
• Reveal SoundFX Wave

BY GORDON MCCOMB

Reveal Computer Products is going after the consumer mass market with its Reveal SoundFX and Reveal SoundFX Wave sound cards. Eye-catchingly low street prices and simple installation (including a how-to video) are the hooks for less-sophisticated users, and Reveal has not sacrificed playback sound quality in the process. The $69.99 SoundFX delivers usable FM-synthesis sound for games and edutainment titles. The $160 SoundFX Wave—the least expensive wavetable-equipped sound card in this roundup—produces good MIDI playback and sound

It's 3:50 pm. You've just finished the final revision to the sales plan. Then the phone rings. "We're sending over 10 new pages of competitive info." Click. Good thing they lock the windows on this floor. You have to get it into the plan by the end of the day. What now?



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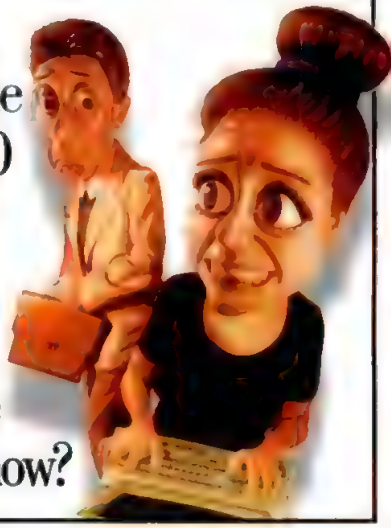

quality that should suit most mainstream business users and game players.

Reveal has succeeded in making setup mercifully easy, thanks to the installation video and excellent documentation. The cards feature a software-only setup scheme that informs you if the desired settings will cause a conflict and offers the next-best option. The boards accommodate standard IDE CD-ROM drives, as well as drives with proprietary connectors from Mitsumi, Panasonic, and Sony.

Because it lacks wavetable ROM, the SoundFX is not a good choice for serious MIDI file listening. Though you can can attach a Wave Blaster or other wavetable daughterboard to it, you're on your own if you do; the manual says nothing about it.

The SoundFX does offer excellent .WAV file playback, though. It showed good frequency response and low intermodulation distortion levels on our Digital Playback tests, especially for a board in this price range. Our samples sounded clear, with little noticeable background hiss or other noise. Be warned, though, that the card is a horrible candidate if you plan to do any recording: Frequency response on our Digital Recording test was abysmal.

SUITABILITY TO TASK

Reveal SoundFX

MIDI composition	FAIR
Business applications	GOOD
Multimedia authoring	POOR
Games and edutainment	EXCELLENT

The SoundFX Wave, with Reveal's own wavetable implementation, offers excellent MIDI file playback. A generous 228 MIDI instruments are sampled. And although the wavetable ROM contains only 1MB of samples, all the instruments sounded full-bodied and realistic. The SoundFX Wave also performed well on the critical THD+N and S/N Ratio tests. On the subjective listening tests, the SoundFX Wave was clear and distinct.

SUITABILITY TO TASK

Reveal SoundFX Wave

MIDI composition	GOOD
Business applications	GOOD
Multimedia authoring	GOOD
Games and edutainment	EXCELLENT

The SoundFX Wave comes with a suite of apps from Voyetra Technologies: Audio Calendar, Sound Script, WAV Sound Effects, Windows Jukebox, WinDAT, MusiClips, MIDI Orchestrator, Sound Events, and Audio Screen Saver. The SoundFX has all of the same (minus the Audio Screen Saver and WAV Sound Effects) and also comes with Sound Script for DOS, CD-Player, and MIDI WAVE Command Line Player.

The documentation adequately covers the software, but there is room for improvement here. It's far too generic and doesn't offer step-by-step help. Reveal is known for its toll-free support, but we were never able to connect; the line was always busy. A Reveal spokesperson promises the company is in the process of adding more support operators and an automated fax-back system. Still, these Reveal boards offer admirable audio integrity at an unbeatable price.

▶ **Reveal SoundFX.** List price: *$69.99.* **Reveal SoundFX Wave.** List price: *$160.* Reveal Computer Products, *6045 Variel Ave., Woodland Hills, CA 91367; 800-326-2222, 818-704-6300; fax, 818-594-8477.*

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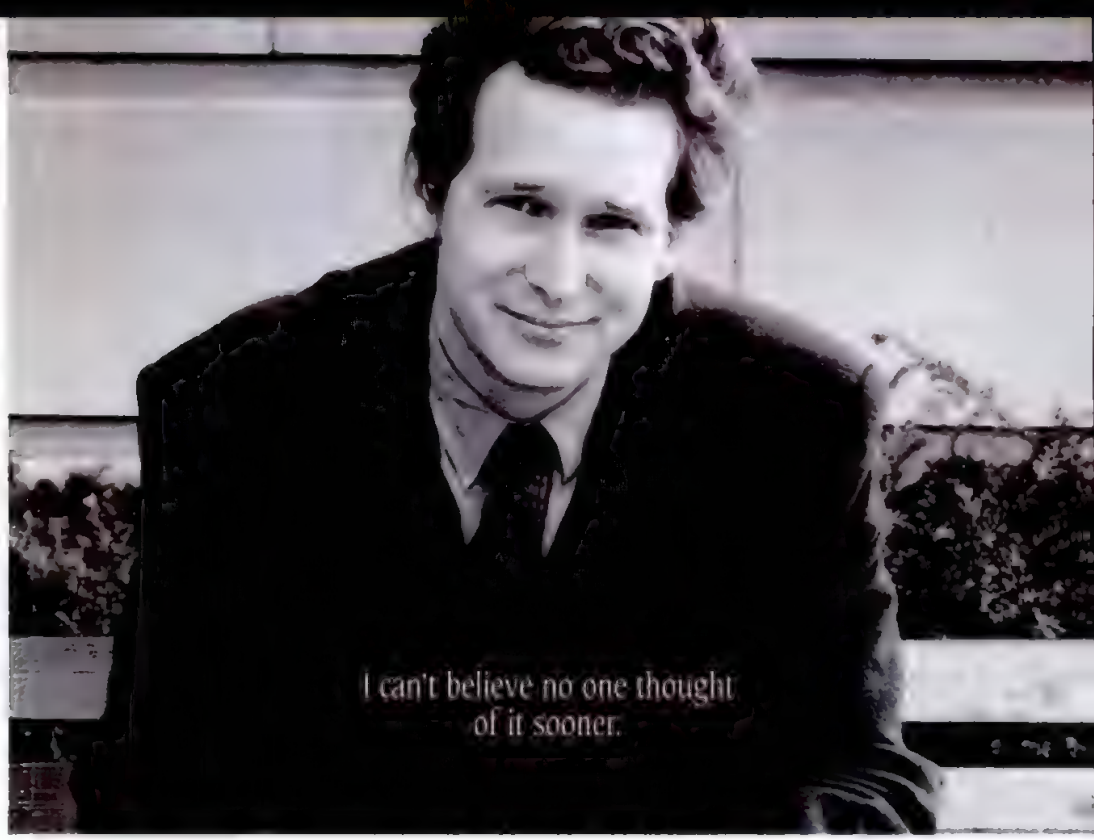

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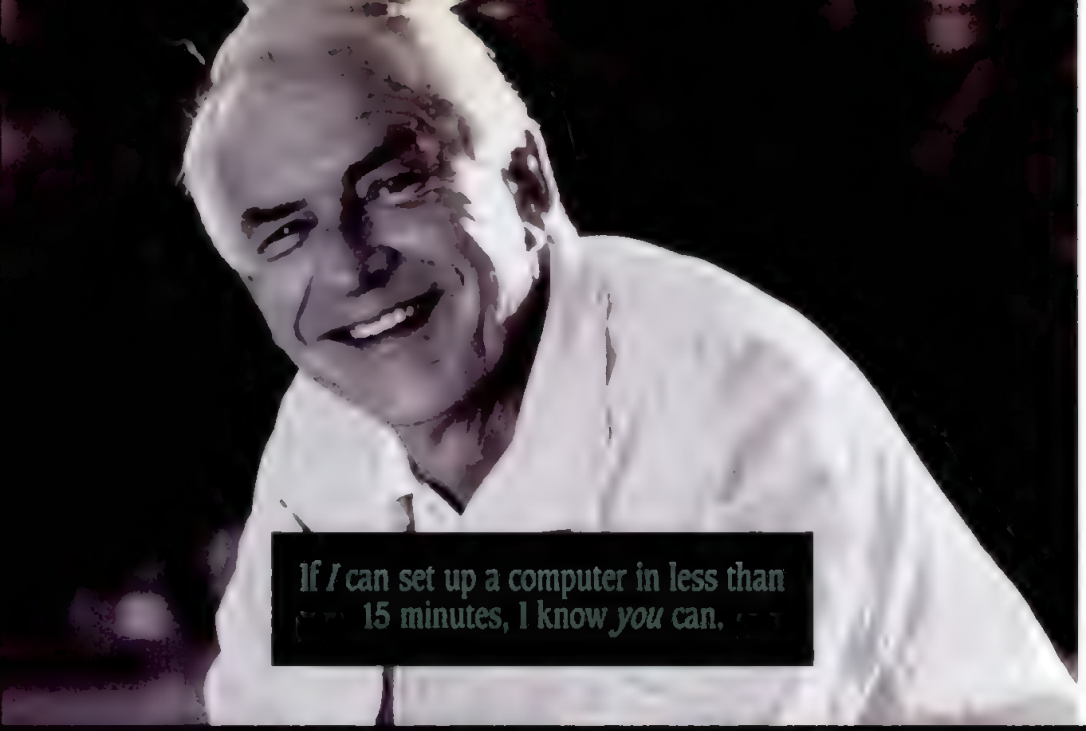

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PC Magazine, Dec. 20, 1994

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Turtle Beach Systems

Turtle Beach Monte Carlo

EDITORS' CHOICE

Turtle Beach Multi-Sound Monterey
Turtle Beach Tropez

BY JOHN R. QUAIN

Turtle Beach Systems used to target only sound purists with its top-shelf sound card offerings. The company has now decided to reach out to business users and game players with its current line. The high-fidelity Turtle Beach MultiSound has undergone some changes and become the Turtle Beach MultiSound Monterey ($399 list, $329 street), while two new boards have been added: the midrange Turtle Beach Tropez ($249 list, $229 street) and the low-end Turtle Beach Monte Carlo ($149 list, $99 street). Though the Monterey continues the company's traditional dedication to great sound, the Tropez sacrifices some sonic accuracy for improved compatibility. The Monte Carlo's inferior sound quality makes it a bad bet, even for game players.

If no-compromise sound quality is what you're after, the Monterey is what you want. It doesn't offer Sound Blaster or Ad Lib compatibility and it doesn't have a built-in CD-ROM drive controller, but MIDI composers and multimedia journeymen will find it has one of the best wavetable MIDI synthesizers and the most accurate digital recording and playback available. Turtle Beach's Hurricane architecture on the Monterey allows you to record and play back samples simultaneously. It doesn't use up a DMA channel, but you have to dedicate 32K of upper memory.

The Monterey's Windows-based software installation was simple and straightforward. If you do run afoul of other boards in your system, the software will help diagnose the conflict and let you change the IRQ settings—though you'll need to set a DIP switch to effect I/O port changes. The new Monterey uses a different MIDI wavetable than the one used in the original MultiSound. Gone is the earlier E-MU Proteus 1 in favor of ICS's WaveFront with 4MB of 16-bit samples. Though better than most, it offers less impressive wavetable than the original Proteus. Several of the presets, such as the bagpipes, are not very realistic. On the other hand, the bundled Windows software allows you to set up any .WAV file as a sample and can adjust a variety of synthesizer parameters (absorption, predelay) in real time.

SUITABILITY TO TASK Turtle Beach Monte Carlo	
MIDI composition	POOR
Business applications	FAIR
Multimedia authoring	POOR
Games and edutainment	FAIR

The Monterey produced the best Frequency Response results, especially on digital playback. The board also produced a clear, clean signal and first-rate channel separation, making it an excellent choice for producing faithful digital recordings.

If you don't require absolutely top-notch sound and want to be able to play all those Sound Blaster–compatible games on your PC, Turtle Beach now offers the Tropez. Although it lacks the

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DSP and Hurricane architecture of the Monterey, Turtle Beach's Tropez is still a solid front-runner. It comes with a separate microphone input and a full suite of Windows applets: a patch editor for MIDI work (WavePatch), a MIDI songwriting program (Stratos), an OLE-compatible .WAV file recorder (MicroWave), a .WAV file editor (Wave SE), and a stereo system–like graphic front end (Sierra) for playing back various sound sources—including audio CDs. Like the Monterey, however, there's no built-in amplifier, so you'll need quality powered speakers. The Tropez uses the ICS WaveFront wavetable and 2MB of sample ROM. Three SIMM slots can accommodate up to 12MB of RAM. This board does include an ATAPI/IDE controller for a CD-ROM drive. Installation was quick and easy, though the combination DOS/Windows setup software can be confusing if you run into problems or conflicts.

SUITABILITY TO TASK Turtle Beach Tropez	
MIDI composition	EXCELLENT
Business applications	EXCELLENT
Multimedia authoring	EXCELLENT
Games and edutainment	GOOD

The Tropez doesn't offer the sound quality of the Monterey, but it's not far behind. Digital recordings were good, but they lacked the overall fidelity of the Monterey's recordings, with some luster lost in the higher treble range.

The inexpensive Monte Carlo is aimed squarely at game players with limited finances. It does include a 4-watt-per-channel amplifier and interfaces to support CD-ROM drives from Mitsumi, Panasonic, and Sony. It comes with the same set of software applets as the Tropez, minus WavePatch, and offers Sound Blaster, Windows Sound System, and OLE compatibility. The primary MIDI workhorse here is a Yamaha OPL3 FM synthesizer, although a software-based virtual wavetable is included.

Unfortunately, the Monte Carlo turned in poor audio test results. Frequency response was especially deficient in the lower bass end, with virtually no bass response below 400 Hz. The card's channel separation was so poor (consistently below 20 dB) that one could not reasonably consider the Monte Carlo to be a stereo sound card.

Turtle Beach's Monterey and Tropez cards maintain the company's position as a sound board leader. The Monterey continues to compare very favorably against other leading (and typically more expensive) sound boards; its only drawback is its unwavering commitment to audio fidelity at the expense of compatibility. For those looking for better compatibility, the Tropez makes a more-than-satisfactory compromise. Forget the Monte Carlo. □

SUITABILITY TO TASK Turtle Beach MultiSound Monterey	
MIDI composition	EXCELLENT
Business applications	GOOD
Multimedia authoring	EXCELLENT
Games and edutainment	POOR

▶ **Turtle Beach Monte Carlo.** List price: *$149.* **Turtle Beach Tropez.** List price: *$249.* **Turtle Beach MultiSound Monterey.** List price: *$399.* Turtle Beach Systems, *52 Grumbacher Rd., York, PA 17402; 800-645-5640, 717-767-0200; fax, 717-767-6033.*

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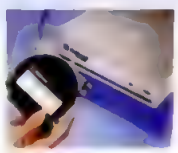
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CIRCLE 175 ON READER SERVICE CARD

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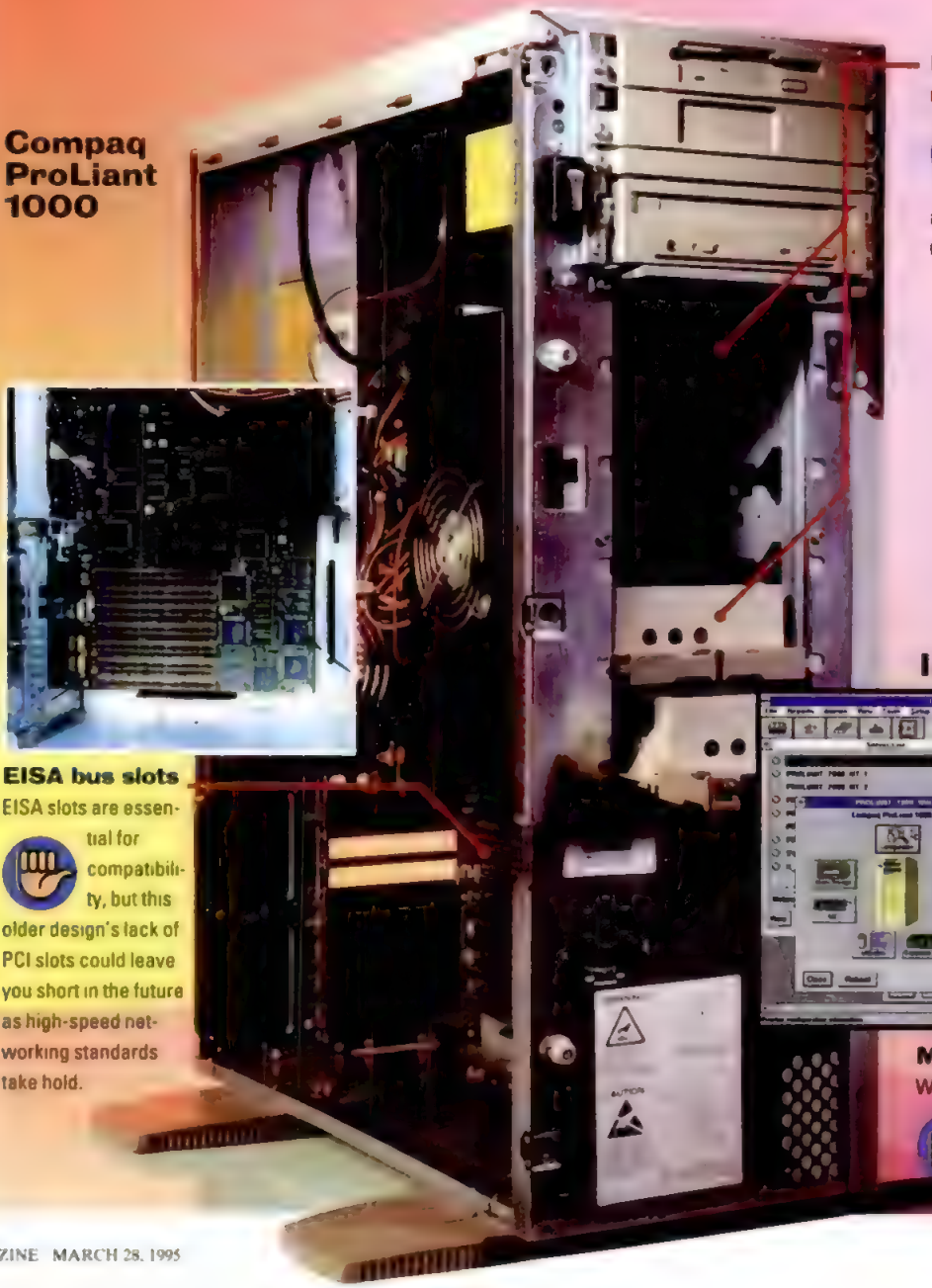
Even more than performance, it's design and usability that separate the great workgroup servers from the merely ordinary. Here are some of the notable features we saw.

Compaq ProLiant 1000



Drive bays and modular hard disks

You couldn't ask for a better arrangement—plenty of drive bays and modular hard disks to ease replacement of failed drives.

EISA bus slots

EISA slots are essential for compatibility, but this older design's lack of PCI slots could leave you short in the future as high-speed networking standards take hold.

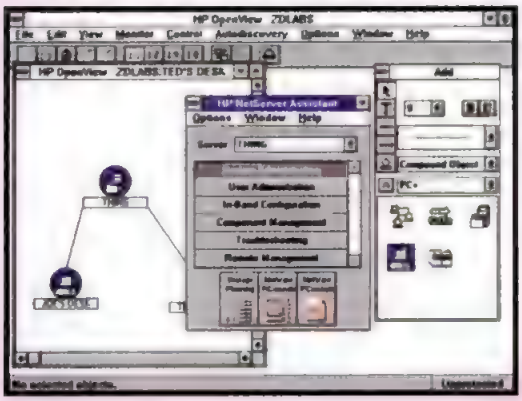
Compaq Insight Manager

Manage your network

With Compaq Insight Manager you can monitor all the servers on your network from one location.

Serve

HP NetServer Assistant 2.0



Monitor your server's health

Hewlett-Packard's NetServer Assistant, Version 2.0, has all the tools you'll need to monitor your server's health, either from the server's console or from a workstation across the network.

Dell PowerEdge

Thumbscrews

The Dell PowerEdge SP590-2 lets you get inside the case with just a turn of a thumbscrew—no tools required. The PowerEdge's case also locks to prevent casual tampering.

Photography by Geoffrey Nelson

Sure, you can flip nearly any PC on its side and serve files to your workgroup. But can a beefed-up PC match the performance and features of these servers?

By Padraic R. Boyle

It wasn't that long ago that network servers were just pumped-up 386s with network interface cards (NICs) and NetWare installed. And in an era when servers' roles were confined to sharing a few files and an expensive laser printer or two, that sort of ad hoc solution made sense. Today, with applications such as electronic mail and groupware products becoming ubiquitous, the demands on servers are increasing dramatically: Desktop machines flipped on their side just won't cut it anymore.

The market for servers continues to diversify as well. A server dedicated to processing order-entry requests from a department of 100 users will look a lot different from one sharing files for a 10-person workgroup. It's this latter category of servers—*workgroup file servers*—that we chose to examine for this review. We specifically limited our focus to file servers, which are essentially central depositories for data. We excluded application servers, the high-powered cornerstones of client/server environments with distinctly different hardware and software requirements.

Depending on your business environment, the definition of *workgroup* could vary. It could mean half a dozen users in a small-office environment. Or it could be a similar number in a branch office or a small department of a major corporation. It could even describe dozens of users at one site if those users rarely needed to gain access to data on the server. Typically, we expect it's the type of environment where you might not usually find a dedicated server closet nor, perhaps, a dedicated network administrator. These factors impose different demands for usability than at the next rung up the server ladder, *departmental file servers*. (For a review of 15 de-

partmental file servers, see "File Servers: Data on Demand," *PC Magazine*, October 11, 1994.)

REVIEW CRITERIA

Because our past experience has shown file servers to be more than just desktops on steroids, we set a strict filter on the systems we accepted for this review. Most importantly, we required that every server come with server-specific documentation; we don't think would-be network administrators should have to cope with desktop-oriented manuals describing DOS commands and how to use a mouse. A few vendors shipped us machines that were desktop systems in the guise of servers, and in the course of testing them we found that they really didn't measure up to the others. (See the sidebar "Almost' Doesn't Cut It" for details.)

Our requirements for system configuration mirrored those we believe to be typical for small file servers: a 486DX2/66 or faster processor, 32MB of RAM, 2GB of hard disk space, and a single 10-megabit-per-second Ethernet 10BaseT adapter. We also required a 3.5-inch floppy disk drive and a CD-ROM drive. To provide a level basis for performance comparison, we requested that vendors not set up disk mirroring or RAID (Redundant Array of Inexpensive Disks). Further, since the performance of disk subsystems in servers can be improved by distributing data among a larger number of physical devices, or *spindles*, we specified that vendors use no more than two spindles. Thus configurations of either two 1GB disks or a single 2GB disk were permissible, but such unrealistic setups as six disks of 340MB apiece were ruled out.

Since graphics is unimportant for most servers—NetWare will work fine on a monochrome monitor—we specified only vanilla VGA controllers and monitors. That's enough to run any server-management packages that can take advantage of graphics.

We had each vendor preinstall NetWare, Version 3.12, with a 25-user license. We do not, however, include the price of the NetWare license (about $2,000) in system prices because the price may vary depending on how you buy your machine. Some vendors will install NetWare for end-user buyers, while others rely on their value-added resellers (VARs) to preinstall NetWare.

We also asked each vendor to supply its preferred server-management package if one was available. In most cases, these server-management packages are options that range in price from $445 to $1,095.

Two additional components that we did not require but that you'll want to consider in any workgroup server are a DAT tape-backup system (about $1,000) and a UPS (about $500). (For a discussion of tape-backup technologies, see "QIC-3110/QIC-3020 Drives: The Bigger Backup," *PC Magazine*, February 7, 1995.)

Seven servers met our stringent requirements: one each from AST Research, Dell Computer Corp., Hewlett-Packard, IBM, and Tangent, and two from Compaq. Compaq's entries—the ProSignia 500 Model 5/90-2100 and the ProLiant 1000 Model 5/60-2100A—are distinctly different machines from two different product families. The ProSignia family is more directly oriented toward workgroup solutions, while the ProLiant 1000 is the entry-level machine in the ProLiant line, which as a whole is targeted toward higher-volume, mission-critical applications and includes multiprocessor models. Interestingly, the ProSignia 500 outperformed the ProLiant 1000 on our tests and provided more features, such as a high-speed PCI bus—all at a lower price. But the ProLiant 1000 offers hot-swappable hard disks, which the ProSignia 500 lacks.

We were unable to test products from

• Compaq ProSignia 500 Model5/90-2100

The seven NetWare file servers in this roundup are truly an outstanding crop; we think any of them would be suitable for most workgroup environments. On the whole, they were evenly balanced in performance, expandability, manageability, and price. But one machine stood just above the others, providing a comprehensive solution with excellent out-of-box feel: the $7,191 Compaq ProSignia 500 Model 5/90-2100. The ProSignia 500 is built around a 90-MHz Pentium processor, and it integrates an Ethernet interface, Fast SCSI-2 hard disk controller, and the graphics controller onto the motherboard. One PCI slot, three EISA slots, and one shared EISA/PCI slot are provided, all of them available in the tested configuration.

What's really impressive about the ProSignia 500 is the software that comes with it. Compaq's SmartStart makes configuring the server about as easy as plugging it in, inserting a disk, and following the directions on-screen. Insight Manager provides comprehensive system-monitoring capabilities and can help keep the ProSignia 500 performing optimally.

For the workgroup, we think the ProSignia 500 is an even better solution than the $10,569 ProLiant 1000 Model 5/60-2100A, a machine that Compaq positions as a step up. A slightly different ProLiant 1000 model was an Editors' Choice winner in our review of departmental file servers ("File Servers: Data on Demand," October 11, 1994). But it doesn't support PCI and, while it has more expansion slots and drive bays, its performance in this review was not quite as strong as that of the ProSignia 500.

An honorable mention goes to the IBM PC Server 300. At $5,499, the PC Server 300 is the lowest-priced machine we tested. It doesn't skimp on performance or features, but we didn't feel it was quite as well-rounded as the ProSignia. The PC Server 300 is IBM's first server product to employ industry-standard EISA and PCI buses rather than the company's proprietary Micro Channel architecture.

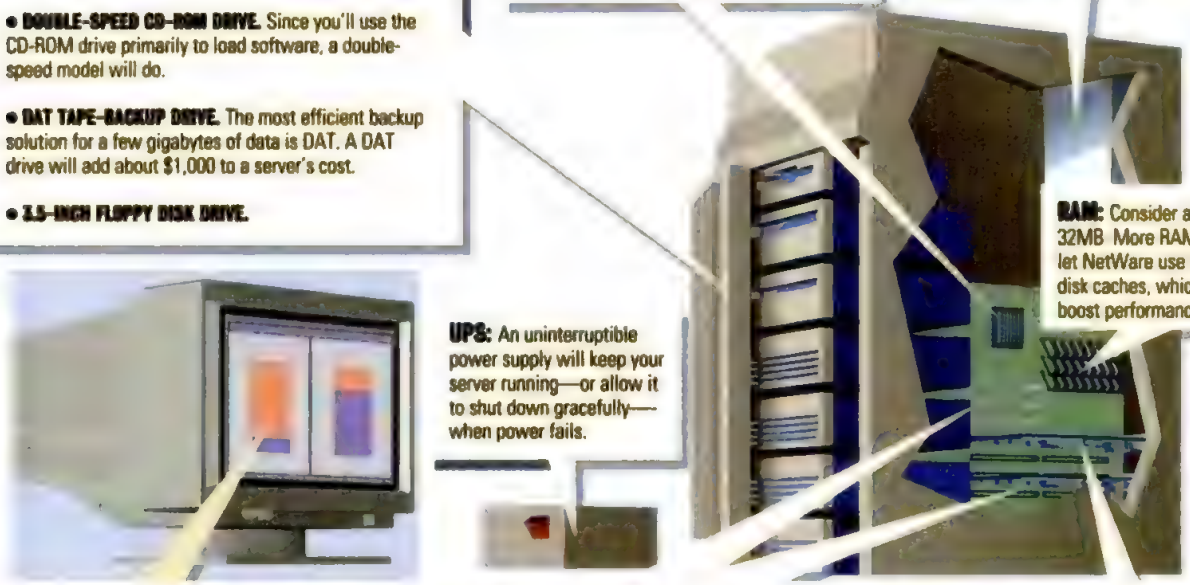
HIGHLIGHTS: WORKGROUP FILE SERVERS

DRIVE BAYS: You'll need at least five drive bays in almost any server for devices such as a

- **DISK SUBSYSTEM.** Boost your server's performance by spreading data across multiple disks, or *spindles*, so that time-consuming head movements are minimized.
- **DOUBLE-SPEED CD-ROM DRIVE.** Since you'll use the CD-ROM drive primarily to load software, a double-speed model will do.
- **DAT TAPE-BACKUP DRIVE.** The most efficient backup solution for a few gigabytes of data is DAT. A DAT drive will add about $1,000 to a server's cost.
- **3.5-INCH FLOPPY DISK DRIVE.**

PROCESSOR: CPU speed isn't critical in I/O-intensive server environments; the HP NetServer proves that a 486 chip will suffice in a well-tuned design. But six of the seven servers tested use Pentium CPUs, providing a hedge against future demands for CPU power.

POWER SUPPLY: Since servers often get loaded down with expansion cards and hard disks, consider a 200-watt supply to be a bare minimum.



RAM: Consider at least 32MB. More RAM will let NetWare use larger disk caches, which can boost performance.

UPS: An uninterruptible power supply will keep your server running—or allow it to shut down gracefully—when power fails.

MANAGEMENT SOFTWARE: Good server management software such as Compaq Insight Manager and HP NetServer Assistant 2.0 will keep your network running smoothly.

ETHERNET NIC AND EISA/PCI BUS: For a network of a dozen or so users, a single Ethernet segment should be adequate. To keep CPU utilization at a reasonable level, opt for a bus-mastering EISA or PCI NIC.

SCSI CONTROLLER: Servers invariably use SCSI rather than IDE because of its greater expandability and better support for multitasking operating systems.

Acer America Corp., AT&T Global Information Solutions, Digital Equipment Corp., and Zenith Data Systems, which were introducing new server lines during our testing time frame. Advanced Logic Research declined to participate in this review.

ARE THEY RIGHT FOR ME?

We took away one simple fact from our tests of these servers: Any of the seven would be an excellent solution for most workgroups. All of them are designed from the ground up for easy installation and maintenance. And many of the vendors offer a full suite of services, from tailor-made servers to ready-to-use workstations and even the cable to connect them all—an integration role that has traditionally been the province of VARs or in-house staff.

Although these turnkey solutions are appealing, they won't be right for everyone. Don't fool yourself into believing that you don't need hand-holding, whether from a trained network administrator or your VAR. NetWare is a complex and sometimes arcane operating system that requires expertise to maintain.

These servers can also be relatively costly: from $5,499 to $10,569 (plus the cost of the NetWare license). By comparison, desktop Pentium PCs with 32MB of RAM and 2GB of disk storage are available for about $5,500. The small additional cost—when there is one at all—typically buys you an EISA bus, SCSI support, more comprehensive service, and a NIC. It also accounts for the higher margin that vendors realize on servers.

If you're just trying to share files among a few workstations in a small office, you might wonder if there's not a less expensive, easier-to-administer solution. The answer is yes: A peer-to-peer network may be just what you need.

Unlike server-based networks, where each workstation shares a central, dedicated server, peer-to-peer networks allow each system on the network to share data with every other system. While this sounds intuitively appealing, it has its

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drawbacks: You're susceptible to data being unavailable or even lost if one workstation locks up or loses power. And peer-to-peer networks will be inherently inferior performers; they'll also slow down the individual PCs on the network. (For more information, see "Peer-to-Peer LANs: Peer Pressure," *PC Magazine*, April 26, 1994.)

But if you're looking for a NetWare file server, these seven products provide a strong combination of price, performance, expandability, and out-of-box usability.

PERFORMANCE: TIGHTLY CLUSTERED

We measured server performance using our NetBench, Version 3.0, benchmark tests on a network of up to 15 demanding 386- and 486-based workstations. NetBench's Disk Mix lets us measure *throughput*—the amount of data transferred between the server and workstations—as well as *CPU utilization* on the server, a measure of how efficiently the server is able to process workstations' requests. (Lower CPU utilization numbers are better; they indicate more untapped processing power.) We found little difference in performance among most of the machines, because they were largely *wire-bound*, or fundamentally limited in performance by the speed of the Ethernet network itself. In other words, even with 15 busy clients, we were unable to saturate most of the servers before we saturated the cable that connected them to the workstations.

One way to improve performance of any system is to use more than one hard disk; systems that use only one hard disk often pay a penalty. Spreading data across multiple disks reduces the motion of each individual disk read/write head (and thus the effective access time of the disks). The results generated by the Dell PowerEdge SP590-2 are a prime example of what can happen when multiple disks aren't used. It was configured with a single 2GB hard disk in contrast to the dual 1GB hard disks used in most other machines, and lagged slightly on our tests. In anecdotal testing of the Dell system with a pair of 1GB hard disks, we found its performance reached levels comparable with those of the other machines in this roundup.

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  15 NetWare file servers.

INSIDE A WORKGROUP SERVER

All but one of the workgroup servers we tested—Hewlett-Packard's HP NetServer 4/66 LC—employed an Intel Pentium processor running at either 60 MHz or 90 MHz. A fast CPU doesn't necessarily make for a fast server, however; factors such as the speed of the hard-disk subsystem, memory subsystem, and NIC and drivers tend to be far more important in I/O-intensive applications like file service. The HP NetServer is proof: It was an average performer overall on our tests in spite of its unpretentious 486DX2/66 processor.

Three of the servers—the ProLiant 1000, the PowerEdge, and the Tangent unit, the Just'NCase SMP Workgroup Server—support an optional second processor. However, these machines' CPU utilization results of roughly 30 percent, coupled with the fact that NetWare doesn't currently support multiple processors, make this capability of dubious value for servers in this category.

All of the machines except the AST Manhattan G560 provide the EISA bus that has become a de facto standard in servers. It's notable that the IBM PC Server 300 is that company's first server product to embrace EISA rather than IBM's Micro Channel architecture, which despite its technical strengths never achieved widespread acceptance. All of the servers except the ProLiant 1000 also support the high-speed PCI bus, which provides a growth path for future high-speed networking standards like 100BaseT. (Compaq will begin shipping the ProLiant 1500, which does offer a PCI bus, in March.) We think an EISA/PCI combination gives you the best of both worlds today: a proven base of compatible products, with room to grow. Eventually, we ex-

Suitability to Task: Workgroup File Servers

Because we required the servers submitted for review to include server-related documentation—something few vendors can provide—these seven products represent the cream of the crop. They show the greatest attention to detail and engineering. As a result, their Suitability to Task scores are high almost across the board. *Good* scores were the norm, and *excellent* scores were commonplace.

SUITABILITY TO TASK	
Ease of Setup/ Operation	POOR
Performance	FAIR
Expandability/ Scalability	GOOD
Security/Fault tolerance	EXCELLENT

The **ease of setup/operation** rating reflects how simple a server is to configure and tune. We emphasize ease of setup and maintenance and the quality of the server-management software and documentation. Other factors include warranty terms, tech-support hours, and other sources of support such as BBSs. Servers rated *excellent* are easily set up and maintained and provide detailed documentation, comprehensive software tools, and extensive warranties.

The **performance** rating measures how well a server performed on our NetBench tests. Servers rated *excellent* marry high throughput with low CPU utilization.

The **expandability/scalability** rating reflects a server's ability to be upgraded. Principal considerations include the number of drive bays, maximum RAM support, power-supply wattage and the number and type of expansion slots (with an emphasis on EISA and PCI slots). Units rated *excellent* offer spacious cases and plenty of open expansion slots.

The **security/fault-tolerance** rating indicates to what extent a server provides redundant components and implements basic security features. We take into consideration the presence of BIOS-based passwords, case key locks, hot-swappable hard disks, and multiple power supplies. Systems rated *excellent* deliver strong insurance against data and hardware tampering.

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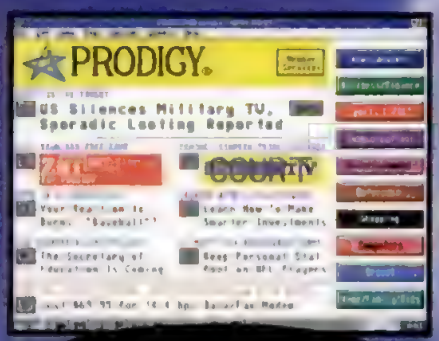

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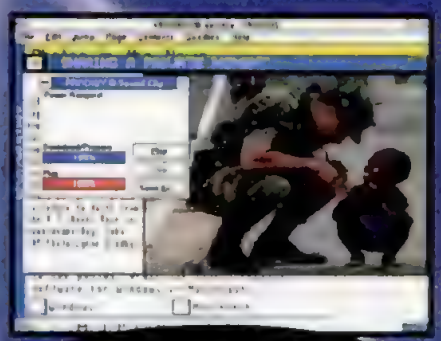

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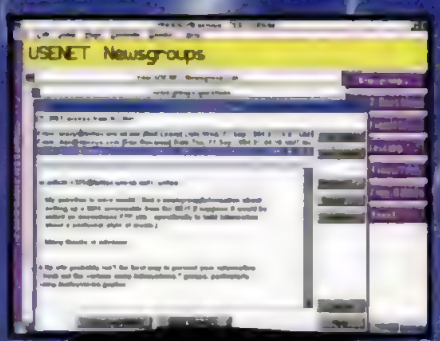

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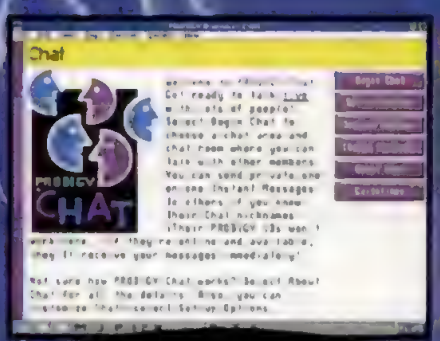

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The board utilizes Yamaha's OPL4 wavetable chip set and is backward-compatible to OPL3 through software emulation: The board has five labeled ports: amp/line-out, joystick/MIDI, line-in, monaural mic, and a 9-pin port for a MIDI expansion box. Standard IDE CD-ROM drives are supported, as are proprietary interfaces from Mitsumi, Panasonic, and Sony. Installation was simple enough, but if you run into a resource conflict (as we did with our Adaptec SCSI adapter), you have to diagnose the problem yourself and change the settings manually. Other boards we reviewed now handle this for you through software. Documentation for the board was adequate, but could use an index.

SUITABILITY TO TASK miroSound PCM 1 Pro	
MIDI composition	GOOD
Business applications	GOOD
Multimedia authoring	GOOD
Games and edutainment	GOOD

The miroSound was one of the most noise-free cards we tested, achieving an impressive 85 dBr S/N ratio. On our Digital Playback tests, there was a slight loss of bass notes below 100 Hz, although other numbers were above average. The power amp, however, needs some work: The card is not capable of delivering clean sound above 0.5 watts (you'll want to use your own powered speakers).

Sound from the board was crisp and clean—more than adequate for business applications, games, and most CD titles. The Yamaha wavetable produced good MIDI playback in general; drums and piano are realistic, although some strings sound a little artificial.

The package ships with several applications, including Sonic Foundry's Sound Forge, a sound editing and effects package; Dynaware USA's Ballade Lite, a MIDI sequencer and notation application; and Ulead Systems' HQ 9000, a media rack that includes an audio CD player, sound mixer, and .WAV file player. A proprietary seven-channel stereo mixer is also bundled. Business users will have to purchase business-audio apps separately.

With the miroSound PCM 1 PRO, the company has made a respectable debut into the sound card market. A complete software-based installation would be welcome, but for the price, the miroSound offers solid wavetable sound quality that should suit all but high-end users.

► **miroSound PCM 1 PRO.** List price: *$229.* miro Computer Products Inc., *955 Commercial St., Palo Alto, CA 94303; 800-249-6476, 415-855-0940; fax, 415-855-9004.*

Circle 482 on reader service card

New Media Corp.

• New Media .WAVjammer

BY BENJAMIN F. MILLER

For notebook computer users who need a lot of sound in a little space, New Media Corp. offers its New Media .WAVjammer 16-bit PCMCIA sound card. The $399 bundle ($269 street), which includes a copy of Microsoft Windows Sound System, is aimed squarely at business users who need sound on the road, particularly for presentations. Voice and sound effects are the card's strong suit. Its FM synthesis is passable for educational titles and games when work is done, though the .WAVjammer is not Sound Blaster–compatible.

The card does not provide SCSI or any other CD-ROM connections. It does ship with a portable microphone and a dongle with microphone inputs, line inputs, and a headphone/speaker jack. Installation took just a matter of minutes. New Media provides SystemSoft's card and socket services, which recognized the card immediately. The .WAVjammer is also compatible with the Intel/Microsoft Plug and Play specification for PCMCIA devices.

SUITABILITY TO TASK New Media .WAVjammer	
MIDI composition	POOR
Business applications	EXCELLENT
Multimedia authoring	POOR
Games and edutainment	FAIR

The .WAVjammer turned in mixed performance on our tests. Preamplifier THD+N was a low 0.01 percent. It also had the best Quantization Noise score on our Digital Recording tests. If you needed to fix a presentation on the road, sound quality from the card would suffice. Our Frequency Response tests, however, showed some drop in signal strength above 1 kHz. In subjective testing we did notice that, while music files played well enough, they lost a little strength at the high end of the spectrum. Voice and sound effects files played clearly and realistically on the .WAVjammer; MIDI files sounded synthetic.

Microsoft Windows Sound System provides a broad range of business audio tools. It features basic mixers, an audio CD player, an OLE-capable recorder, and a voice-command program, Voice Pilot. ProofReader, a text-to-speech program, rounds out the set. Also handy is the Sound Finder program for cataloging and easily locating .WAV files on your PC.

Though the .WAVjammer has excellent audio characteristics, you might expect wavetable synthesis and better MIDI reproduction for the money. Alas, getting a sound card into this small design has its price. If your career hinges on presentations on the road, the .WAVjammer delivers most of the goods.

► **New Media .WAVjammer.** List price: *$399.* New Media Corp., *1 Technology, Bldg. A, Irvine, CA 92718; 800-227-3748, 714-453-0100; fax, 714-453-0114.*

Circle 483 on reader service card

Orchid Technology

• Orchid SoundWave 32 Pro SCSI
• Orchid SoundWave 32+ Studio

BY BENJAMIN F. MILLER

With the Orchid SoundWave 32 Pro SCSI ($279 list, $210 street) and the Orchid SoundWave 32+ Studio ($399 list, $290 to $320 street), Orchid Technology has targeted gamers, edutainment users, and MIDI enthusiasts. Orchid has revamped its offerings since we last visited its products, greatly improving both the installation procedure and sound quality. Indeed, these wavetable-equipped boards deliver audio that is pleasing to the ear and software utilities that are useful and well-implemented.

Orchid's Windows-hosted installation program is unbelievably easy to use. You can change sound card configurations on the fly (no need to reboot your PC), and the cards' drivers have to be executed only once (either manually or in AUTOEXEC .BAT) and take up no memory in DOS.

The more expensive Studio is aimed squarely at MIDI enthusiasts. It delivers a total of 6MB of samples (versus the Pro

SCSI's 2MB) in its *two* wavetable MIDI synthesizers; the main synthesizer is from Euphonics, the second from Crystal/ Dream. This arrangement delivers more polyphony—up to 56 simultaneous voices instead of 32—as well as built-in effects like reverb, chorus, flanging, echo, and delay. For the more casual game and edutainment user, the Pro SCSI's standard wavetable should satisfy.

SUITABILITY TO TASK Orchid SoundWave 32 Pro SCSI	
MIDI composition	FAIR
Business applications	GOOD
Multimedia authoring	GOOD
Games and edutainment	EXCELLENT

On our objective performance tests, the cards' frequency response curves were close to ideal flatness through the entire audio range. THD+N and S/N Ratio figures placed them in the middle of the pack. On subjective tests, both Orchid cards produced clear and full sound with distinct voices while playing .WAV files. Both are also Sound Blaster–compatible and produced music and sound effects from DOS games with distinction. The Studio, especially, delivered strong MIDI playback with well-defined voices and dynamic transitions from loud to soft passages.

SUITABILITY TO TASK Orchid SoundWave 32+ Studio	
MIDI composition	GOOD
Business applications	GOOD
Multimedia authoring	GOOD
Games and edutainment	GOOD

Orchid's graphical Media Rack includes an audio CD player, MIDI player, .WAV file player/recorder, and a mixer. The mixer has three different displays (for playback, recording, and microphone); changing between them is as easy as clicking the mouse. Orchid's mixer also includes six presets that let you store preferences for different audio uses. Both the .WAV file player and the MIDI player include character displays that indicate the file being played.

Orchid's cards deliver the sound quality and feature set most wide-eyed gamers or edutainment users want. If your audio work involves MIDI, you will probably want to consider the Studio.

▶ **Orchid SoundWave 32 Pro SCSI.** List price: *$299.* **Orchid SoundWave 32+ Studio.** List price: *$349.* Orchid Technology, *45365 Northport Loop West, Fremont, CA 94538; 800-767-2443, 510-683-0300; fax, 510-490-9312.*

Circle 484 on reader service card

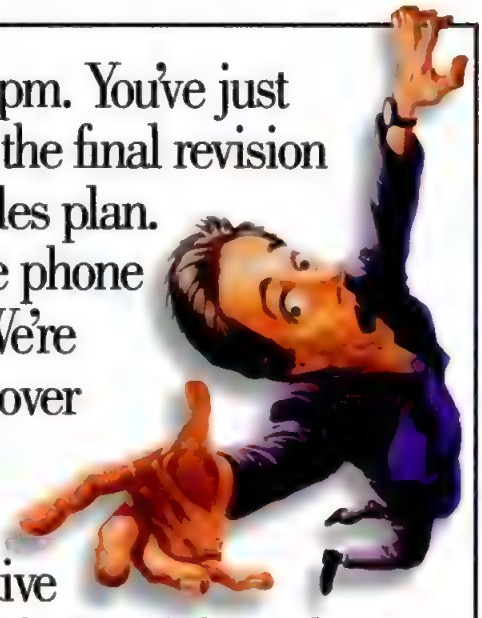
Reveal Computer Products

• Reveal SoundFX
• Reveal SoundFX Wave

BY GORDON MCCOMB

Reveal Computer Products is going after the consumer mass market with its Reveal SoundFX and Reveal SoundFX Wave sound cards. Eye-catchingly low street prices and simple installation (including a how-to video) are the hooks for less-sophisticated users, and Reveal has not sacrificed playback sound quality in the process. The $69.99 SoundFX delivers usable FM-synthesis sound for games and edutainment titles. The $160 SoundFX Wave—the least expensive wavetable-equipped sound card in this roundup—produces good MIDI playback and sound

It's 3:50 pm. You've just finished the final revision to the sales plan. Then the phone rings. "We're sending over 10 new pages of competitive info." Click. Good thing they lock the windows on this floor. You have to get it into the plan by the end of the day. What now?



You think she's finishing the proposal. She thinks you are. Surprise, neither one of you is. And it's 4 hours before the grant committee meets. Let's see, 16 new pages of data, 11 article reviews, 3,600 words sent by your partners in Istanbul. Who can type faster? What now?

quality that should suit most mainstream business users and game players.

Reveal has succeeded in making setup mercifully easy, thanks to the installation video and excellent documentation. The cards feature a software-only setup scheme that informs you if the desired settings will cause a conflict and offers the next-best option. The boards accommodate standard IDE CD-ROM drives, as well as drives with proprietary connectors from Mitsumi, Panasonic, and Sony.

Because it lacks wavetable ROM, the SoundFX is not a good choice for serious MIDI file listening. Though you can can attach a Wave Blaster or other wavetable daughterboard to it, you're on your own if you do; the manual says nothing about it.

The SoundFX does offer excellent .WAV file playback, though. It showed good frequency response and low intermodulation distortion levels on our Digital Playback tests, especially for a board in this price range. Our samples sounded clear, with little noticeable background hiss or other noise. Be warned, though,

SUITABILITY TO TASK Reveal SoundFX	
MIDI composition	FAIR
Business applications	GOOD
Multimedia authoring	POOR
Games and edutainment	EXCELLENT

that the card is a horrible candidate if you plan to do any recording: Frequency response on our Digital Recording test was abysmal.

The SoundFX Wave, with Reveal's own wavetable implementation, offers excellent MIDI file playback. A generous 228 MIDI instruments are sampled. And although the wavetable ROM contains only 1MB of samples, all the instruments sounded full-bodied and realistic. The SoundFX Wave also performed well on the critical THD+N and S/N Ratio tests. On the subjective listening tests, the SoundFX Wave was clear and distinct.

SUITABILITY TO TASK Reveal SoundFX Wave	
MIDI composition	GOOD
Business applications	GOOD
Multimedia authoring	GOOD
Games and edutainment	EXCELLENT

The SoundFX Wave comes with a suite of apps from Voyetra Technologies: Audio Calendar, Sound Script, WAV Sound Effects, Windows Jukebox, WinDAT, MusiClips, MIDI Orchestrator, Sound Events, and Audio Screen Saver. The SoundFX has all of the same (minus the Audio Screen Saver and WAV Sound Effects) and also comes with Sound Script for DOS, CD-Player, and MIDI WAVE Command Line Player.

The documentation adequately covers the software, but there is room for improvement here. It's far too generic and doesn't offer step-by-step help. Reveal is known for its toll-free support, but we were never able to connect; the line was always busy. A Reveal spokesperson promises the company is in the process of adding more support operators and an automated fax-back system. Still, these Reveal boards offer admirable audio integrity at an unbeatable price.

▶ **Reveal SoundFX.** List price: *$69.99.* **Reveal SoundFX Wave.** List price: *$160.* Reveal Computer Products, *6045 Variel Ave., Woodland Hills, CA 91367; 800-326-2222, 818-704-6300; fax, 818-594-8477.*

Circle 485 on reader service card

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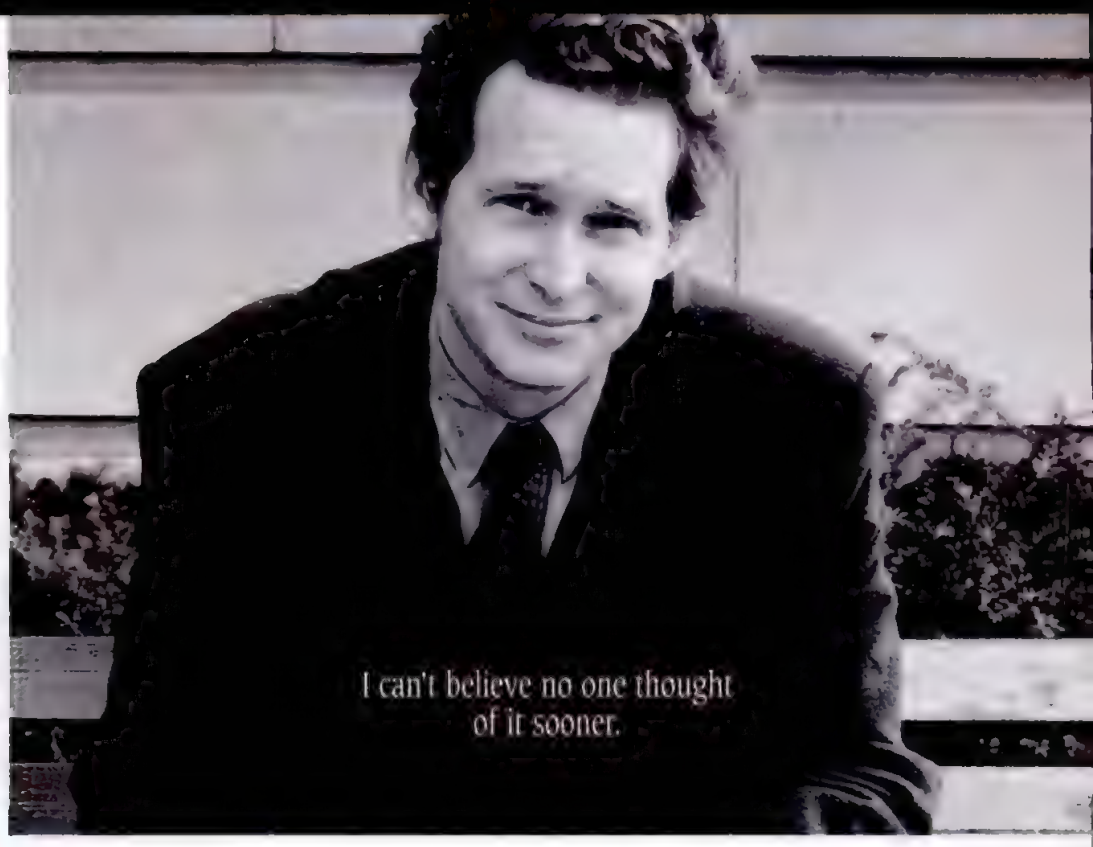

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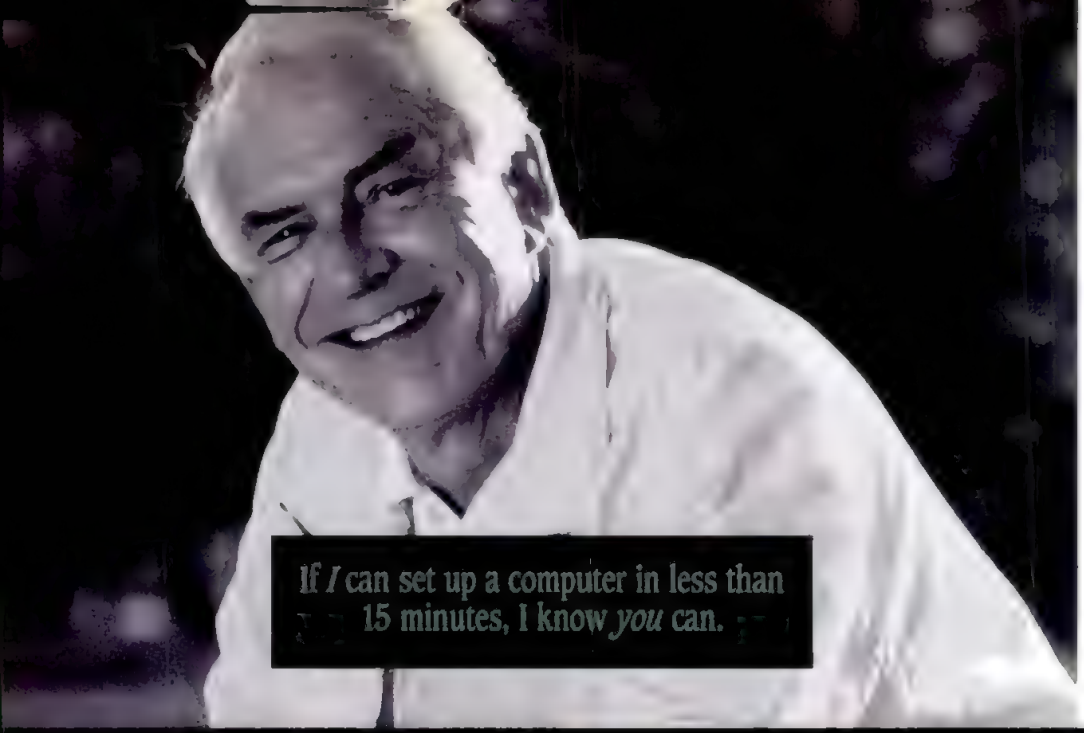

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CIRCLE 273 ON READER SERVICE CARD

Turtle Beach Systems

• Turtle Beach Monte Carlo

EDITORS' CHOICE

Turtle Beach Multi-Sound Monterey

Turtle Beach Tropez

BY JOHN R. QUAIN

Turtle Beach Systems used to target only sound purists with its top-shelf sound card offerings. The company has now decided to reach out to business users and game players with its current line. The high-fidelity Turtle Beach MultiSound has undergone some changes and become the Turtle Beach MultiSound Monterey ($399 list, $329 street), while two new boards have been added: the midrange Turtle Beach Tropez ($249 list, $229 street) and the low-end Turtle Beach Monte Carlo ($149 list, $99 street). Though the Monterey continues the company's traditional dedication to great sound, the Tropez sacrifices some sonic accuracy for improved compatibility. The Monte Carlo's inferior sound quality makes it a bad bet, even for game players.

If no-compromise sound quality is what you're after, the Monterey is what you want. It doesn't offer Sound Blaster or Ad Lib compatibility and it doesn't have a built-in CD-ROM drive controller, but MIDI composers and multimedia journeymen will find it has one of the best wavetable MIDI synthesizers and the most accurate digital recording and playback available. Turtle Beach's Hurricane architecture on the Monterey allows you to record and play back samples simultaneously. It doesn't use up a DMA channel, but you have to dedicate 32K of upper memory.

The Monterey's Windows-based software installation was simple and straightforward. If you do run afoul of other boards in your system, the software will help diagnose the conflict and let you change the IRQ settings—though you'll need to set a DIP switch to effect I/O port changes. The new Monterey uses a different MIDI wavetable than the one used in the original MultiSound. Gone is the earlier E-MU Proteus 1 in favor of ICS's WaveFront with 4MB of 16-bit samples. Though better than most, it offers less impressive wavetable than the original Proteus. Several of the presets, such as the bagpipes, are not very realistic. On the other hand, the bundled Windows software allows you to set up any .WAV file as a sample and can adjust a variety of synthesizer parameters (absorption, predelay) in real time.

SUITABILITY TO TASK Turtle Beach Monte Carlo	
MIDI composition	POOR
Business applications	FAIR
Multimedia authoring	POOR
Games and edutainment	FAIR

The Monterey produced the best Frequency Response results, especially on digital playback. The board also produced a clear, clean signal and first-rate channel separation, making it an excellent choice for producing faithful digital recordings.

If you don't require absolutely top-notch sound and want to be able to play all those Sound Blaster–compatible games on your PC, Turtle Beach now offers the Tropez. Although it lacks the

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DSP and Hurricane architecture of the Monterey, Turtle Beach's Tropez is still a solid front-runner. It comes with a separate microphone input and a full suite of Windows applets: a patch editor for MIDI work (WavePatch), a MIDI songwriting program (Stratos), an OLE-compatible .WAV file recorder (MicroWave), a .WAV file editor (Wave SE), and a stereo system–like graphic front end (Sierra) for playing back various sound sources—including audio CDs. Like the Monterey, however, there's no built-in amplifier, so you'll need quality powered speakers. The Tropez uses the ICS WaveFront wavetable and 2MB of sample ROM. Three SIMM slots can accommodate up to 12MB of RAM. This board does include an ATAPI/IDE controller for a CD-ROM drive. Installation was quick and easy, though the combination DOS/Windows setup software can be confusing if you run into problems or conflicts.

SUITABILITY TO TASK Turtle Beach Tropez	
MIDI composition	EXCELLENT
Business applications	EXCELLENT
Multimedia authoring	EXCELLENT
Games and edutainment	GOOD

The Tropez doesn't offer the sound quality of the Monterey, but it's not far behind. Digital recordings were good, but they lacked the overall fidelity of the Monterey's recordings, with some luster lost in the higher treble range.

The inexpensive Monte Carlo is aimed squarely at game players with limited finances. It does include a 4-watt-per-channel amplifier and interfaces to support CD-ROM drives from Mitsumi, Panasonic, and Sony. It comes with the same set of software applets as the Tropez, minus WavePatch, and offers Sound Blaster, Windows Sound System, and OLE compatibility. The primary MIDI workhorse here is a Yamaha OPL3 FM synthesizer, although a software-based virtual wavetable is included.

Unfortunately, the Monte Carlo turned in poor audio test results. Frequency response was especially deficient in the lower bass end, with virtually no bass response below 400 Hz. The card's channel separation was so poor (consistently below 20 dB) that one could not reasonably consider the Monte Carlo to be a stereo sound card.

Turtle Beach's Monterey and Tropez cards maintain the company's position as a sound board leader. The Monterey continues to compare very favorably against other leading (and typically more expensive) sound boards; its only drawback is its unwavering commitment to audio fidelity at the expense of compatibility. For those looking for better compatibility, the Tropez makes a more-than-satisfactory compromise. Forget the Monte Carlo. □

SUITABILITY TO TASK Turtle Beach MultiSound Monterey	
MIDI composition	EXCELLENT
Business applications	GOOD
Multimedia authoring	EXCELLENT
Games and edutainment	POOR

▶ **Turtle Beach Monte Carlo.** List price: *$149.* **Turtle Beach Tropez.** List price: *$249.* **Turtle Beach MultiSound Monterey.** List price: *$399.* Turtle Beach Systems, *52 Grumbacher Rd., York, PA 17402; 800-645-5640, 717-767-0200; fax, 717-767-6033.*

Circle 486 on reader service card

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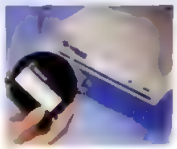

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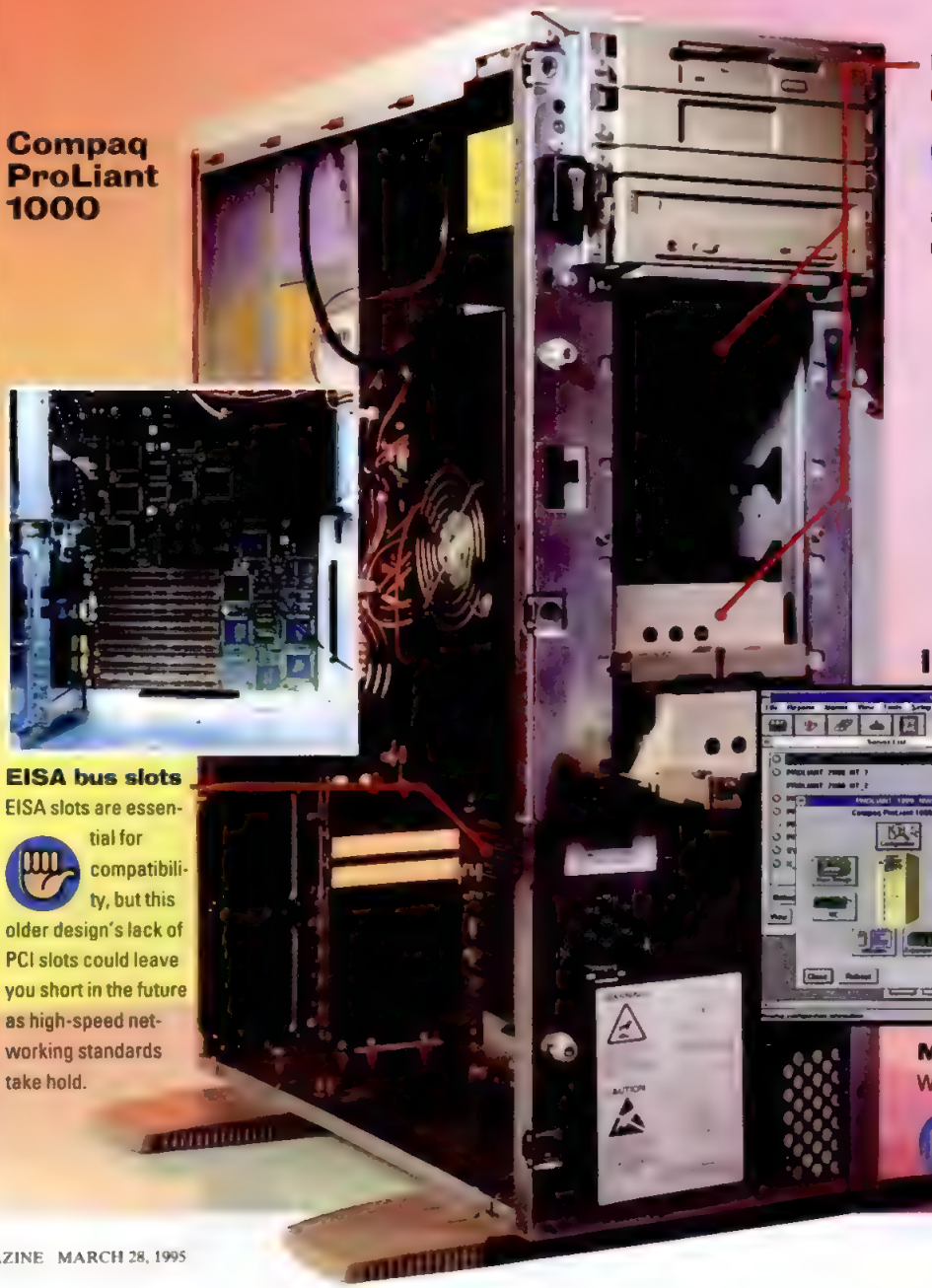
CIRCLE 175 ON READER SERVICE CARD

Born to

Even more than performance, it's design and usability that separate the great workgroup servers from the merely ordinary. Here are some of the notable features we saw.

Compaq ProLiant 1000



Drive bays and modular hard disks

You couldn't ask for a better arrangement—plenty of drive bays and modular hard disks to ease replacement of failed drives.

Compaq Insight Manager

EISA bus slots

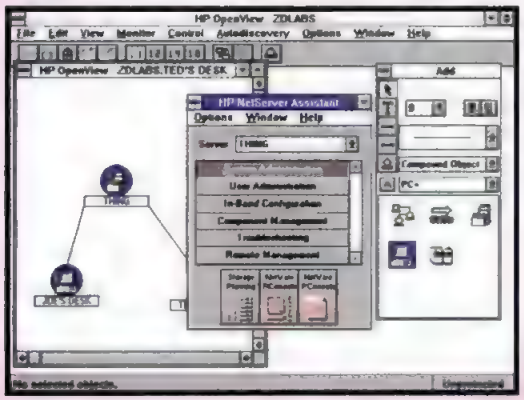
EISA slots are essential for compatibility, but this older design's lack of PCI slots could leave you short in the future as high-speed networking standards take hold.

Manage your network

With Compaq Insight Manager you can monitor all the servers on your network from one location.

Serve

HP NetServer Assistant 2.0



Monitor your server's health

Hewlett-Packard's NetServer Assistant, Version 2.0, has all the tools you'll need to monitor your server's health, either from the server's console or from a workstation across the network.

Dell PowerEdge

Thumbscrews

The Dell PowerEdge SP590-2 lets you get inside the case with just a turn of a thumbscrew—no tools required. The PowerEdge's case also locks to prevent casual tampering.

Sure, you can flip nearly any PC on its side and serve files to your workgroup. But can a beefed-up PC match the performance and features of these servers?

By Padraic R. Boyle

It wasn't that long ago that network servers were just pumped-up 386s with network interface cards (NICs) and NetWare installed. And in an era when servers' roles were confined to sharing a few files and an expensive laser printer or two, that sort of ad hoc solution made sense. Today, with applications such as electronic mail and groupware products becoming ubiquitous, the demands on servers are increasing dramatically: Desktop machines flipped on their side just won't cut it anymore.

The market for servers continues to diversify as well. A server dedicated to processing order-entry requests from a department of 100 users will look a lot different from one sharing files for a 10-person workgroup. It's this latter category of servers—*workgroup file servers*—that we chose to examine for this review. We specifically limited our focus to file servers, which are essentially central depositories for data. We excluded application servers, the high-powered cornerstones of client/server environments with distinctly different hardware and software requirements.

Depending on your business environment, the definition of *workgroup* could vary. It could mean half a dozen users in a small-office environment. Or it could be a similar number in a branch office or a small department of a major corporation. It could even describe dozens of users at one site if those users rarely needed to gain access to data on the server. Typically, we expect it's the type of environment where you might not usually find a dedicated server closet nor, perhaps, a dedicated network administrator. These factors impose different demands for usability than at the next rung up the server ladder, *departmental file servers.* (For a review of 15 de-

Photography by Geoffrey Nelson

partmental file servers, see "File Servers: Data on Demand," *PC Magazine*, October 11, 1994.)

REVIEW CRITERIA

Because our past experience has shown file servers to be more than just desktops on steroids, we set a strict filter on the systems we accepted for this review. Most importantly, we required that every server come with server-specific documentation; we don't think would-be network administrators should have to cope with desktop-oriented manuals describing DOS commands and how to use a mouse. A few vendors shipped us machines that were desktop systems in the guise of servers, and in the course of testing them we found that they really didn't measure up to the others. (See the sidebar "Almost' Doesn't Cut It" for details.)

Our requirements for system configuration mirrored those we believe to be typical for small file servers: a 486DX2/66 or faster processor, 32MB of RAM, 2GB of hard disk space, and a single 10-megabit-per-second Ethernet 10BaseT adapter. We also required a 3.5-inch floppy disk drive and a CD-ROM drive. To provide a level basis for performance comparison, we requested that vendors not set up disk mirroring or RAID (Redundant Array of Inexpensive Disks). Further, since the performance of disk subsystems in servers can be improved by distributing data among a larger number of physical devices, or *spindles,* we specified that vendors use no more than two spindles. Thus configurations of either two 1GB disks or a single 2GB disk were permissible, but such unrealistic setups as six disks of 340MB apiece were ruled out.

Since graphics is unimportant for most servers—NetWare will work fine on a monochrome monitor—we specified only vanilla VGA controllers and monitors. That's enough to run any server-management packages that can take advantage of graphics.

We had each vendor preinstall NetWare, Version 3.12, with a 25-user license. We do not, however, include the price of the NetWare license (about $2,000) in system prices because the price may vary depending on how you buy your machine. Some vendors will install NetWare for end-user buyers, while others rely on their value-added resellers (VARs) to preinstall NetWare.

We also asked each vendor to supply its preferred server-management package if one was available. In most cases, these server-management packages are options that range in price from $445 to $1,095.

Two additional components that we did not require but that you'll want to consider in any workgroup server are a DAT tape-backup system (about $1,000) and a UPS (about $500). (For a discussion of tape-backup technologies, see "QIC-3110/QIC-3020 Drives: The Bigger Backup," *PC Magazine,* February 7, 1995.)

Seven servers met our stringent requirements: one each from AST Research, Dell Computer Corp., Hewlett-Packard, IBM, and Tangent, and two from Compaq. Compaq's entries—the ProSignia 500 Model 5/90-2100 and the ProLiant 1000 Model 5/60-2100A—are distinctly different machines from two different product families. The ProSignia family is more directly oriented toward workgroup solutions, while the ProLiant 1000 is the entry-level machine in the ProLiant line, which as a whole is targeted toward higher-volume, mission-critical applications and includes multiprocessor models. Interestingly, the ProSignia 500 outperformed the ProLiant 1000 on our tests and provided more features, such as a high-speed PCI bus—all at a lower price. But the ProLiant 1000 offers hot-swappable hard disks, which the ProSignia 500 lacks.

We were unable to test products from

• Compaq ProSignia 500 Model5/90-2100

The seven NetWare file servers in this roundup are truly an outstanding crop; we think any of them would be suitable for most workgroup environments. On the whole, they were evenly balanced in performance, expandability, manageability, and price. But one machine stood just above the others, providing a comprehensive solution with excellent out-of-box feel: the $7,191 Compaq ProSignia 500 Model 5/90-2100.

The ProSignia 500 is built around a 90-MHz Pentium processor, and it integrates an Ethernet interface, Fast SCSI-2 hard disk controller, and the graphics controller onto the motherboard. One PCI slot, three EISA slots, and one shared EISA/PCI slot are provided, all of them available in the tested configuration.

What's really impressive about the ProSignia 500 is the software that comes with it. Compaq's SmartStart makes configuring the server about as easy as plugging it in, inserting a disk, and following the directions on-screen. Insight Manager provides comprehensive system-monitoring capabilities and can help keep the ProSignia 500 performing optimally.

For the workgroup, we think the ProSignia 500 is an even better solution than the $10,569 ProLiant 1000 Model 5/60-2100A, a machine that Compaq positions as a step up. A slightly different ProLiant 1000 model was an Editors' Choice winner in our review of departmental file servers ("File Servers: Data on Demand," October 11, 1994). But it doesn't support PCI and, while it has more expansion slots and drive bays, its performance in this review was not quite as strong as that of the ProSignia 500.

An honorable mention goes to the IBM PC Server 300. At $5,499, the PC Server 300 is the lowest-priced machine we tested. It doesn't skimp on performance or features, but we didn't feel it was quite as well-rounded as the ProSignia. The PC Server 300 is IBM's first server product to employ industry-standard EISA and PCI buses rather than the company's proprietary Micro Channel architecture.

HIGHLIGHTS: WORKGROUP FILE SERVERS

DRIVE BAYS: You'll need at least five drive bays in almost any server for devices such as a

- **DISK SUBSYSTEM.** Boost your server's performance by spreading data across multiple disks, or *spindles*, so that time-consuming head movements are minimized.
- **DOUBLE-SPEED CD-ROM DRIVE.** Since you'll use the CD-ROM drive primarily to load software, a double-speed model will do.
- **DAT TAPE-BACKUP DRIVE.** The most efficient backup solution for a few gigabytes of data is DAT. A DAT drive will add about $1,000 to a server's cost.
- **3.5-INCH FLOPPY DISK DRIVE.**

PROCESSOR: CPU speed isn't critical in I/O-intensive server environments; the HP NetServer proves that a 486 chip will suffice in a well-tuned design. But six of the seven servers tested use Pentium CPUs, providing a hedge against future demands for CPU power.

POWER SUPPLY: Since servers often get loaded down with expansion cards and hard disks, consider a 200-watt supply to be a bare minimum.

RAM: Consider at least 32MB. More RAM will let NetWare use larger disk caches, which can boost performance.

UPS: An uninterruptible power supply will keep your server running—or allow it to shut down gracefully—when power fails.

MANAGEMENT SOFTWARE: Good server management software such as Compaq Insight Manager and HP NetServer Assistant 2.0 will keep your network running smoothly.

ETHERNET NIC AND EISA/PCI BUS: For a network of a dozen or so users, a single Ethernet segment should be adequate. To keep CPU utilization at a reasonable level, opt for a bus-mastering EISA or PCI NIC.

SCSI CONTROLLER: Servers invariably use SCSI rather than IDE because of its greater expandability and better support for multitasking operating systems.

Acer America Corp., AT&T Global Information Solutions, Digital Equipment Corp., and Zenith Data Systems, which were introducing new server lines during our testing time frame. Advanced Logic Research declined to participate in this review.

ARE THEY RIGHT FOR ME?

We took away one simple fact from our tests of these servers: Any of the seven would be an excellent solution for most workgroups. All of them are designed from the ground up for easy installation and maintenance. And many of the vendors offer a full suite of services, from tailor-made servers to ready-to-use workstations and even the cable to connect them all—an integration role that has traditionally been the province of VARs or in-house staff.

Although these turnkey solutions are appealing, they won't be right for everyone. Don't fool yourself into believing that you don't need hand-holding, whether from a trained network administrator or your VAR. NetWare is a complex and sometimes arcane operating system that requires expertise to maintain.

These servers can also be relatively costly: from $5,499 to $10,569 (plus the cost of the NetWare license). By comparison, desktop Pentium PCs with 32MB of RAM and 2GB of disk storage are available for about $5,500. The small additional cost—when there is one at all—typically buys you an EISA bus, SCSI support, more comprehensive service, and a NIC. It also accounts for the higher margin that vendors realize on servers.

If you're just trying to share files among a few workstations in a small office, you might wonder if there's not a less expensive, easier-to-administer solution. The answer is yes: A peer-to-peer network may be just what you need.

Unlike server-based networks, where each workstation shares a central, dedicated server, peer-to-peer networks allow each system on the network to share data with every other system. While this sounds intuitively appealing, it has its

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drawbacks: You're susceptible to data being unavailable or even lost if one workstation locks up or loses power. And peer-to-peer networks will be inherently inferior performers; they'll also slow down the individual PCs on the network. (For more information, see "Peer-to-Peer LANs: Peer Pressure," *PC Magazine*, April 26, 1994.)

But if you're looking for a NetWare file server, these seven products provide a strong combination of price, performance, expandability, and out-of-box usability.

PERFORMANCE: TIGHTLY CLUSTERED

We measured server performance using our NetBench, Version 3.0, benchmark tests on a network of up to 15 demanding 386- and 486-based workstations. NetBench's Disk Mix lets us measure *throughput*—the amount of data transferred between the server and workstations—as well as *CPU utilization* on the server, a measure of how efficiently the server is able to process workstations' requests. (Lower CPU utilization numbers are better; they indicate more untapped processing power.) We found little difference in performance among most of the machines, because they were largely *wire-bound*, or fundamentally limited in performance by the speed of the Ethernet network itself. In other words, even with 15 busy clients, we were unable to saturate most of the servers before we saturated the cable that connected them to the workstations.

One way to improve performance of any system is to use more than one hard disk; systems that use only one hard disk often pay a penalty. Spreading data across multiple disks reduces the motion of each individual disk read/write head (and thus the effective access time of the disks). The results generated by the Dell PowerEdge SP590-2 are a prime example of what can happen when multiple disks aren't used. It was configured with a single 2GB hard disk in contrast to the dual 1GB hard disks used in most other machines, and lagged slightly on our tests. In anecdotal testing of the Dell system with a pair of 1GB hard disks, we found its performance reached levels comparable with those of the other machines in this roundup.

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  15 NetWare file servers.

INSIDE A WORKGROUP SERVER

All but one of the workgroup servers we tested—Hewlett-Packard's HP NetServer 4/66 LC—employed an Intel Pentium processor running at either 60 MHz or 90 MHz. A fast CPU doesn't necessarily make for a fast server, however; factors such as the speed of the hard-disk subsystem, memory subsystem, and NIC and drivers tend to be far more important in I/O-intensive applications like file service. The HP NetServer is proof: It was an average performer overall on our tests in spite of its unpretentious 486DX2/66 processor.

Three of the servers—the ProLiant 1000, the PowerEdge, and the Tangent - unit, the Just'NCase SMP Workgroup Server—support an optional second processor. However, these machines' CPU utilization results of roughly 30 percent, coupled with the fact that NetWare doesn't currently support multiple processors, make this capability of dubious value for servers in this category.

All of the machines except the AST Manhattan G560 provide the EISA bus that has become a de facto standard in servers. It's notable that the IBM PC Server 300 is that company's first server product to embrace EISA rather than IBM's Micro Channel architecture, which despite its technical strengths never achieved widespread acceptance. All of the servers except the ProLiant 1000 also support the high-speed PCI bus, which provides a growth path for future high-speed networking standards like 100BaseT. (Compaq will begin shipping the ProLiant 1500, which does offer a PCI bus, in March.) We think an EISA/PCI combination gives you the best of both worlds today: a proven base of compatible products, with room to grow. Eventually, we ex-

Suitability to Task: Workgroup File Servers

Because we required the servers submitted for review to include server-related documentation—something few vendors can provide—these seven products represent the cream of the crop. They show the greatest attention to detail and engineering. As a result, their Suitability to Task scores are high almost across the board. *Good* scores were the norm, and *excellent* scores were commonplace.

SUITABILITY TO TASK	
Ease of Setup/ Operation	POOR
Performance	FAIR
Expandability/ Scalability	GOOD
Security/Fault tolerance	EXCELLENT

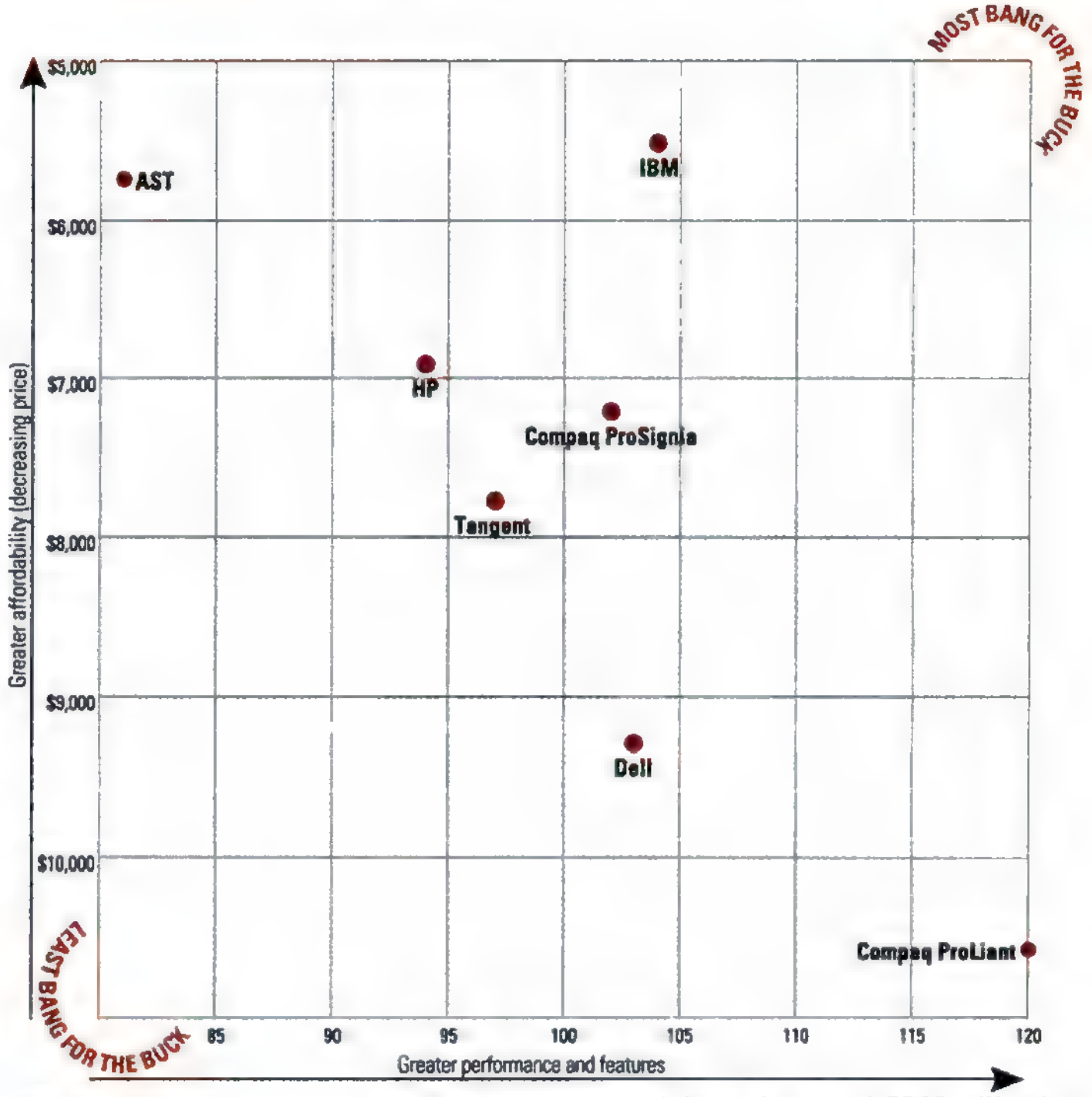
The **ease of setup/operation** rating reflects how simple a server is to configure and tune. We emphasize ease of setup and maintenance and the quality of the server-management software and documentation. Other factors include warranty terms, tech-support hours, and other sources of support such as BBSs. Servers rated *excellent* are easily set up and maintained and provide detailed documentation, comprehensive software tools, and extensive warranties.

The **performance** rating measures how well a server performed on our NetBench tests. Servers rated *excellent* marry high throughput with low CPU utilization.

The **expandability/scalability** rating reflects a server's ability to be upgraded. Principal considerations include the number of drive bays, maximum RAM support, power-supply wattage and the number and type of expansion slots (with an emphasis on EISA and PCI slots). Units rated *excellent* offer spacious cases and plenty of open expansion slots.

The **security/fault-tolerance** rating indicates to what extent a server provides redundant components and implements basic security features. We take into consideration the presence of BIOS-based passwords, case key locks, hot-swappable hard disks, and multiple power supplies. Systems rated *excellent* deliver strong insurance against data and hardware tampering.

Price/Performance Index: *Workgroup File Servers*



The $7,191 Compaq ProSignia 500 Model 5/90-2100, an Editors' Choice winner, combines a competitive price with great performance and features. Its throughput was neck and neck with that of the other two leaders in this roundup, the Compaq ProLiant 1000 Model 5/60-2100A and the Tangent Just'NCase SMP Workgroup Server.

The Compaq ProSignia 500's server-management software, Insight Manager (also featured in the Compaq ProLiant 1000), was the best we saw. Insight Manager covers every aspect of server monitoring imaginable and also has a remote-notification feature. Compaq's SmartStart software (also included) makes server setup simple: An activation code from Compaq accesses the NOS of your choice, and the CD-ROMs do everything from setting up your software and hardware optimally to attempting to fix installation errors.

The Compaq ProLiant 1000 tops the chart in terms of performance and features, but it comes at a high price and seems more suited to the demands of larger networks.

The IBM PC Server 300, though not a performance leader, offers an appealing price tag of only $5,499—the lowest here. It comes with NetFinity, IBM's comprehensive server-management software.

The Dell PowerEdge SP590-2 achieved a high performance/features score, but at $9,193 had the second-highest price. The Dell unit's performance was mixed, with excellent CPU utilization but comparatively poor throughput.

THE DATA POINTS

The seven file servers clustered closely in terms of performance. We think you should look beyond performance, however, when you're considering servers in this category. Quality of the included server-specific documentation and ease of maintenance, therefore, account for about 20 percent of our performance/features score. Other nontechnical elements such as warranty, on-site service, and availability of technical support account for 15 percent of the total. The servers' throughput and CPU utilization results account for 30 percent, while the implementation of server-management software covers 10 percent. Physical characteristics such as the number of drive bays and expansion-bus slots and the maximum RAM supported make up the rest of the score.

You can find additional information in the Hardware Library of the Editorial Forum on PC MagNet under the filename 6BNG95.XLS.—*Analysis written by Mary E. Behr*

pect PCI to replace EISA entirely as the number of stable PCI-compatible peripherals grows and bridge chip sets that let vendors implement more than three PCI slots in a machine become commonplace.

While you're thinking ahead, consider expandability. All of these servers support a system maximum of at least 136MB of RAM, so memory shouldn't be a problem. More important is space for additional mass-storage devices—especially hard disks. The servers here typically offer four to five available half-height drive bays. The HP NetServer is an exception: All but one of its five drive bays were occupied in our test unit.

THE OUT-OF-BOX EXPERIENCE

Given that performance, components, and expandability are relatively similar for many of these machines, it shouldn't be a surprise that key differentiators were the quality of documentation, ease of installation and maintenance, and bundled software. Without a doubt the best-of-breed combination comes from Compaq. Compaq's SmartStart offers a flexible and simple solution for installing a workgroup server and tailoring it to your specific needs. SmartStart is complemented by Compaq's

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Benchmark Tests: Workgroup File Servers

The servers in this roundup all sustained similar throughput levels; their performance was limited by the bandwidth of the single Ethernet segment we used.

What the Numbers Mean

Machines like these that are truly designed to be servers—with their fast, well-tuned disk subsystems and network interface cards (NICs)—can easily sustain enough throughput to saturate a single 10-Mbps Ethernet segment. The best performers in this roundup maximized network throughput and minimized CPU utilization by using efficient NICs. The Compaq ProSignia 500 Model 5/90-2100 had the best combination of throughput and CPU utilization, followed closely by the Tangent Just'NCase SMP Workgroup Server and the Compaq ProLiant 1000 Model 5/60-2100A. Both Compaq systems used the proven Compaq NetFlex-2 NIC; the ProLiant 1000 used the EISA version, while the ProSignia 500 had an integrated PCI version. The Tangent system used a Cogent eMaster+ NIC on the PCI expansion bus.

Although the impact of faster CPUs is not readily apparent in the throughput results, it is clear that they improved CPU utilization. The Compaq ProSignia 500, along with the Dell PowerEdge SP590-2, IBM PC Server 300, and Tangent Just'NCase SMP, posted good CPU Utilization scores. All of these machines use 90-MHz Pentiums, with the exception of the IBM PC Server 300, which is based on a 60-MHz Pentium.

EXAMINING THE SUBSYSTEMS

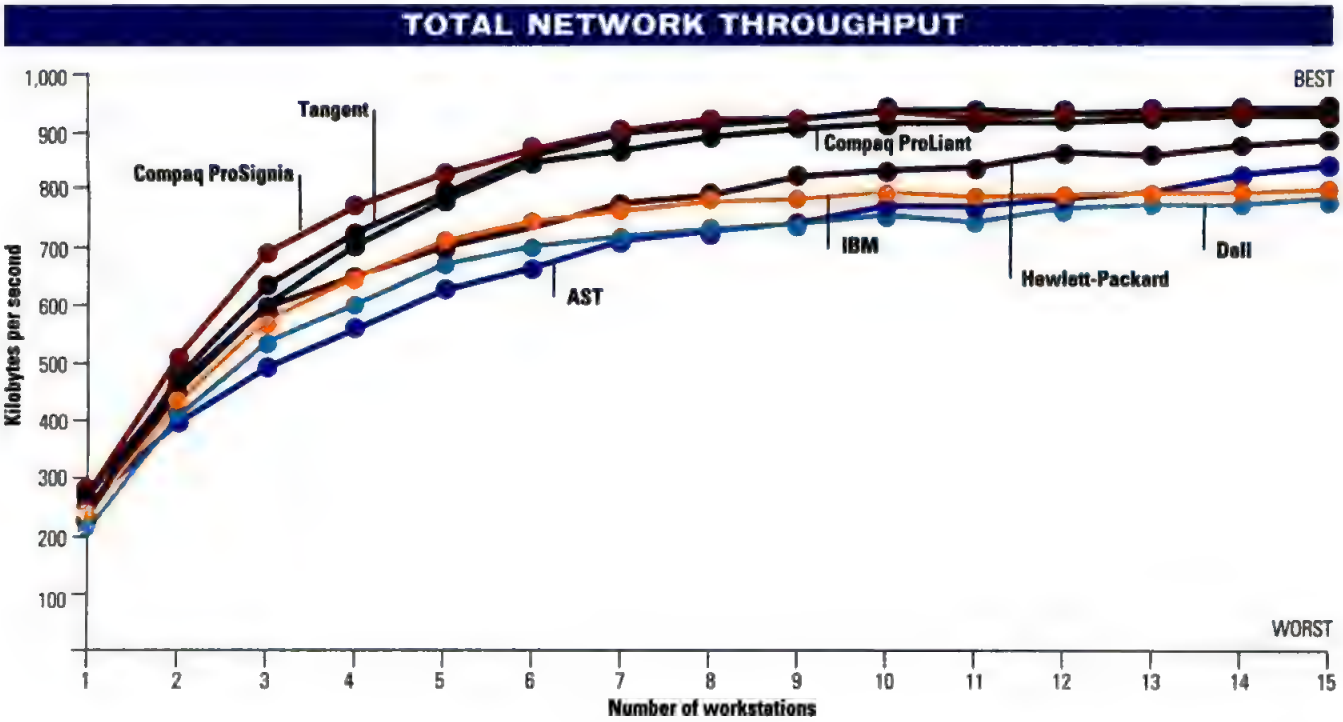
If your network consists of a single physical segment (as our test network did), your server's peak throughput will be limited by the network's maximum bandwidth. In such a scenario, upgrading to faster CPU and disk subsystems will not improve performance, since the network itself is a fundamental bottleneck. To reduce the impact of this bottleneck, it's important that you invest in the right NIC.

All seven of these servers came with bus-mastering EISA or PCI NICs. Not all PCI or EISA NICs are created equal, however. The Compaq NetFlex-2 NICs (both EISA and PCI versions) once again proved to be among the best NICs on the market. The Znyx ZX312, on the other hand, was at the other end of the spectrum, with poor throughput and high CPU utilization. We base this conclusion not just on the results generated here by the AST Manhattan G560, but also on tests we have conducted with other equivalently configured servers on the same test-bed.

Theoretically, PCI-based adapters could outperform EISA adapters, because the PCI bus is capable of transferring data at speeds of up to 132 MBps, compared with EISA's 33 MBps. But we found that machines with EISA NICs performed as well as or better than those with PCI NICs, probably because drivers for the newer PCI NICs are not yet as sophisticated.

An ideal server should also incorporate a fast disk subsystem—that is, one that includes a hard disk, disk controllers, I/O bus, cache, and device drivers. For servers, the disk interface of choice is almost invariably SCSI, specifically Fast SCSI-2.

The Compaq ProLiant 1000 had a 4MB cache on the con-



troller, the largest cache on any of the tested systems. Whether or not spending extra money on a controller cache can help a server's performance depends significantly on individual environments.

Striping data across multiple hard disks, or *spindles*, can dramatically increase performance. The relatively poor performance of the Dell PowerEdge SP590-2 can be explained in part by the fact that the machine used only a single disk. We found in anecdotal testing that adding a second spindle improved throughput.

Our tests show that processor speed is not a crucial factor in server performance in a workgroup environment. In fact, the only system that did not ship with a Pentium chip, the 486DX2/66-based HP NetServer 4/66 LC, outperformed several of the other servers.

READING THE CHARTS

The throughput numbers reported at each client load indicate how much data each server was able to process from the network clients. For most of these servers, throughput was limited by the bandwidth of the Ethernet segment itself (about 1 MBps). Results are reported in kilobytes per second, and higher numbers represent better performance.

CPU Utilization results indicate how much of the processor's computing capacity is required to service workstation requests. Lower numbers represent better performance, because they indicate that more of the CPU's processing power was available for other tasks. Servers that reached high CPU utilization with a relatively small number of clients are not well suited to demanding LAN environments.—*Analysis by Shawn Kafaipour*

How We Tested

We tested these workgroup servers running NetWare 3.12 at ZD Labs. Our 15-node network there consisted of a single Ethernet segment, with ten 486DX/33 PCs and five 386DX/33 PCs from various manufacturers.

We tested each server under 15 different load conditions. We began with one workstation, added an extra workstation, and ran the test again, repeating this process until we reached a maximum load of 15 clients.

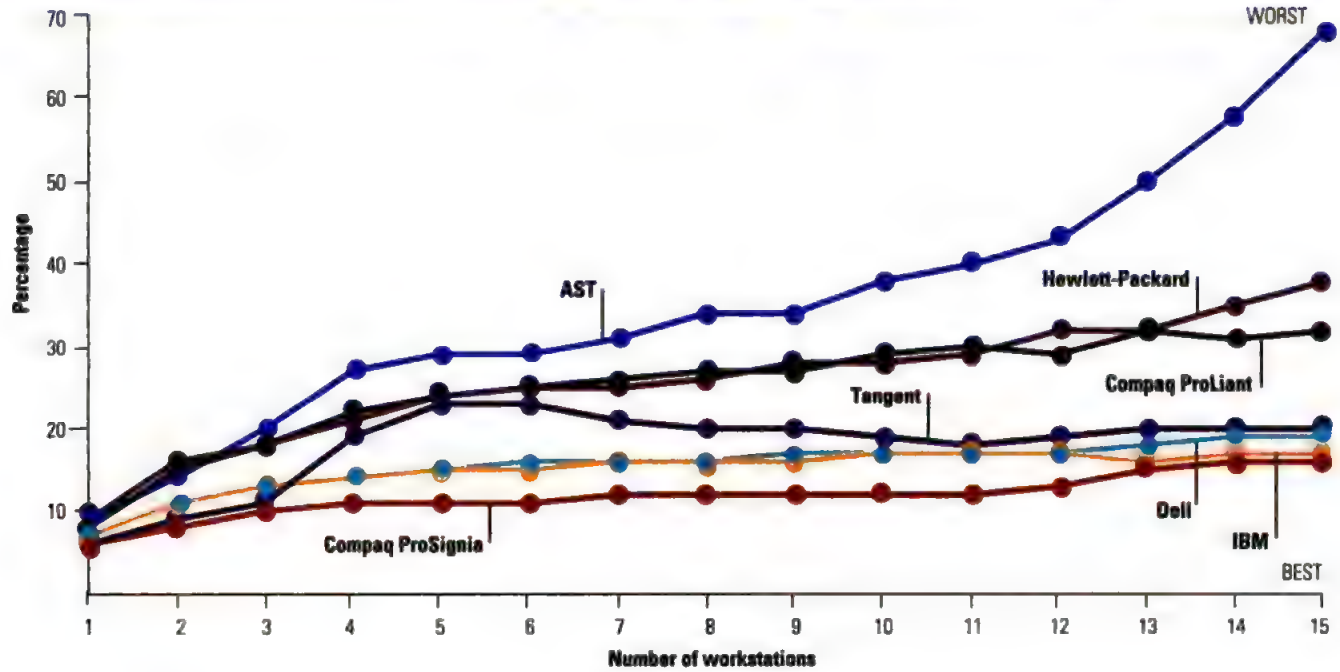
Total Network Throughput results are generated by the Disk Mix portion of NetBench, Version 3.0. NetBench's Disk Mix presents application-level read and write requests through NetWare client software that runs on each workstation; the requests then get transported through the physical network to the server. Since in the course of each test multiple workstations are constantly firing requests at the server, results of a test with a given number of NetBench nodes might actually represent performance typical of a larger network using less demanding workstations.

We set each NetBench client to use 20MB of hard disk space on the server to store the temporary files that the test uses for reads and writes—a total of 300MB of data at the 15-client maximum. NetBench generates read and write requests in a manner that mimics the behavior of real applications based on extensive profiling studies.

NetBench's Disk Mix runs for 11 minutes at each load level to ensure stable and repeatable results. During the entire run, we use NetWare's STAT.NLM utility to monitor CPU utilization at 1-second intervals. Using this information, we generate the **CPU Utilization** scores for each server at each client load. STAT.NLM itself uses a minimal amount of CPU resources and is considered a fixed overhead in all tested servers. Furthermore, we disable the server-management software during testing to eliminate the CPU overhead caused by the management software.

To mimic the performance buyers would see, we allowed vendors to set their own NetWare tuning parameters, select the number of drive spindles and the NetWare volume block size, and choose their own network adapters.

CPU UTILIZATION



excellent Insight Manager, which monitors every imaginable aspect of the server's operation and notifies you either locally or remotely (via pager, e-mail, and so forth) if problems arise. (To use the remote-notification capability provided by these software packages, you'll usually need to buy some additional hardware, such as a modem board, for the server.)

Other strong server-management packages include HP NetServer Assistant, Version 2.0, IBM NetFinity, Version 2.01, and Intel LANDesk, which shipped with the Tangent Just'NCase SMP. AST Percepta deserves plaudits for its ease of use and intuitive, point-and-click graphical interface, but its utility as a real-time monitoring tool is questionable because it doesn't provide any remote notification of problems like overheating; you have to be in front of the screen to see the screen's temperature gauge change from green to red. (For a review of standalone server-management software, see "Network Management: Who's Minding Your Network?," *PC Magazine*, November 8, 1994.)

Once your machine is up and running, you'll want to make sure it stays that way. Don't skimp on service and support. All of these vendors except HP and Tangent offer 24-hour, seven-day telephone technical support; most also provide on-site service for at least the first year of their warranty period. If you're willing to spend extra, you can get AST, Compaq, Dell, HP, and Tangent to commit to a 4-hour on-site response time for $495 to $599 per year. (IBM offers a 4-hour response time standard.)

Whatever your needs, the reviews that follow should help you determine which workgroup server provides the right combination of performance, expandability, and serviceability for your workgroup.

Our Contributors: PADRAIC R. BOYLE is a network consultant and frequent contributor to *PC Magazine*. WILLIAM P. FLANAGAN is a staff writer at *PC Magazine*. MARY E. BEHR is an editorial researcher at *PC Magazine*. JOHN CLYMAN was the associate editor in charge of this story, SHAWN KAFAIPOUR was the senior project leader, and RICHARD FISCO was the project leader.

AST Research Inc.

• AST Manhattan G560

The $5,743 AST Manhattan G560 is built around a 60-MHz Pentium chip. The system, one of the least expensive in this roundup, came in a mini-tower case and includes an ISA-based motherboard, which also provides three PCI slots. AST offers a strong service and support package with the Manhattan as well as its Percepta server-management software, which is limited, but still somewhat useful. The overall design of this machine is marred by the positioning of the unit's expansion slots.

The AST system's slots are on a riser card that plugs into the motherboard and are inverted so that when the unit is standing upright the expansion cards hang upside down. To install cards, you must remove the bottom panel and turn the system on its side or its top to access the slots. This design is almost exactly opposite that of the Dell PowerEdge SP590-2 (also in this roundup). The Dell unit's slots are also located on a riser card on the motherboard;

▪ "Almost" Doesn't Cut It

No longer can you slap a network card into any PC and hope to match the performance of built-for-the-purpose servers.

Four vendors submitted systems for this roundup that didn't meet one of our key filter criteria: Although they had advanced PCI buses and big hard disks with NetWare installed, they lacked server-specific documentation. The systems, from American Multisystems, CompuAdd Computer Corp., Hertz Computer Corp., and Olivetti North America, came with manuals that gave no indication that the units were anything more than typical desktops. And when we tested their performance to see how they stacked up, the difference was apparent.

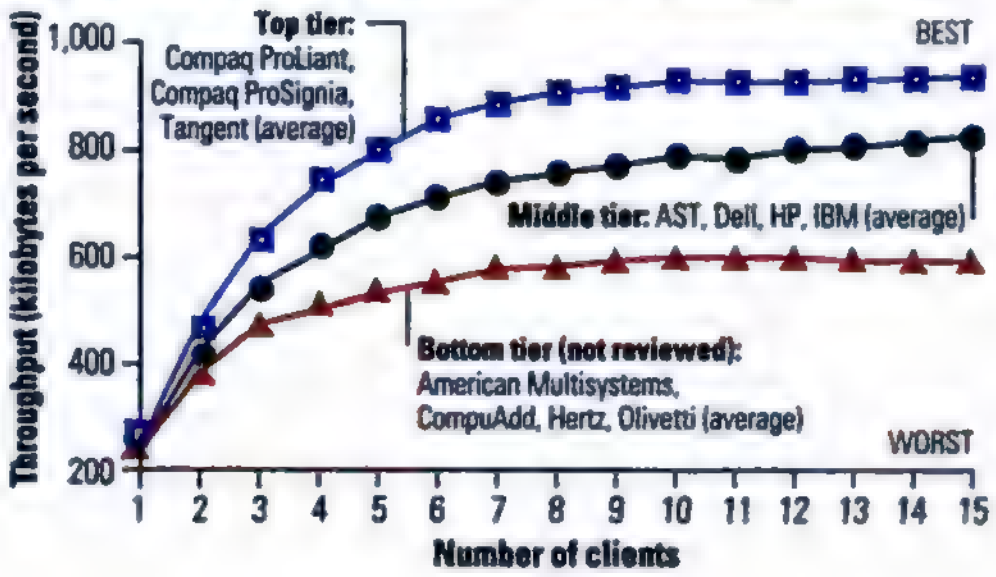
On the Disk Mix portion of NetBench 3.0, which exercises the servers using loads increasing from 1 to 15 client workstations, these four PCs managed only about 70 percent of the throughput of the fastest three systems—the top tier in the diagram. Under heavy loads, they fell to as little as 63 percent of the throughput of the leaders.

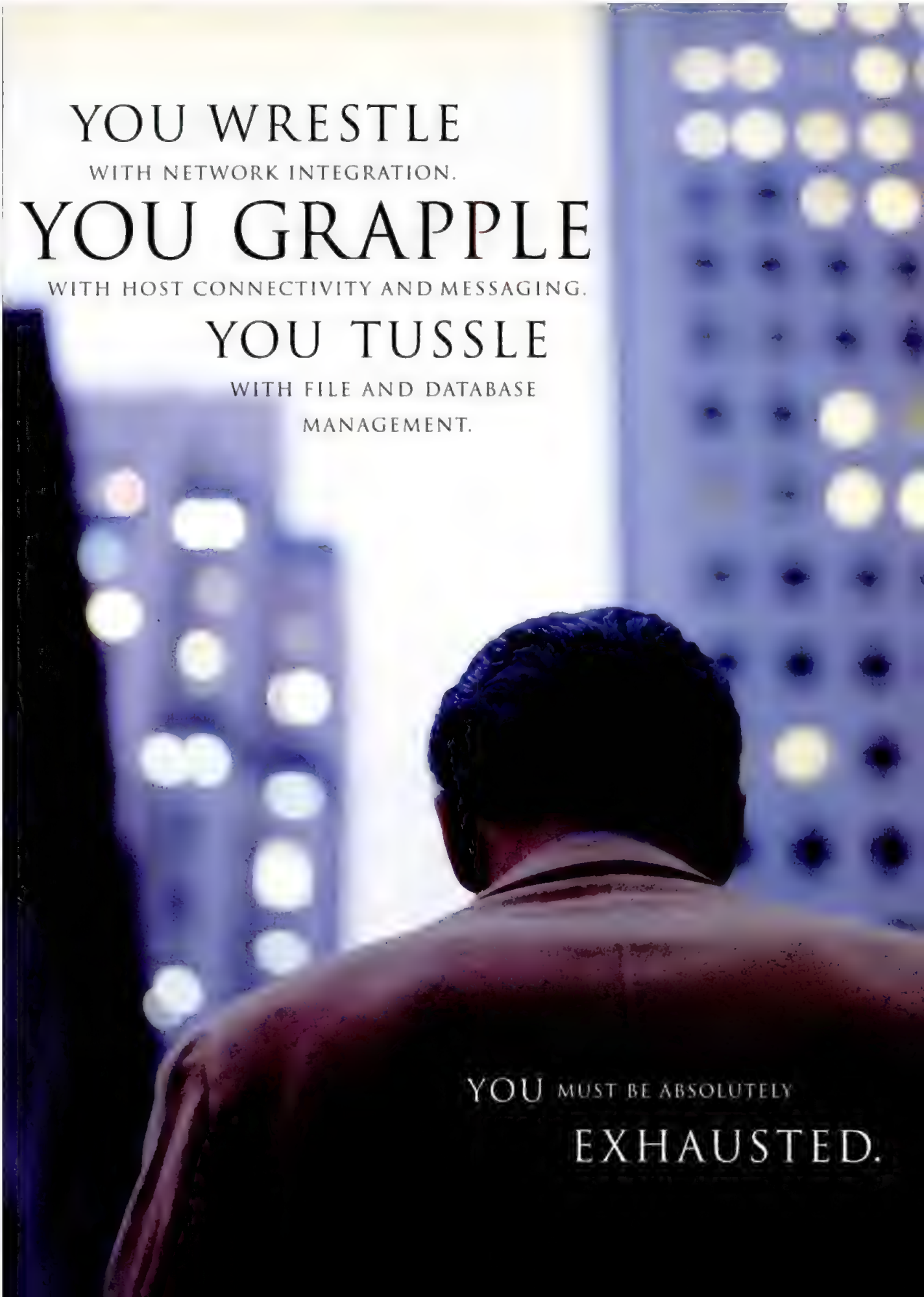
The systems in the middle tier were a bit slower than those in the top tier, averaging about 85 percent of the throughput of the best three. That's still better than the machines in the bottom tier (although the CompuAdd and Olivetti systems did post better throughput scores than the systems from AMS and Hertz did).

Since the leading performers in this category are more and more competitively priced—they cost more, but not significantly more—we believe that if you want a workgroup server, you should look for a product with a server pedigree. Not only will you get better performance, you will find installation and maintenance easier. □

AVERAGE SERVER PERFORMANCE

NetBench 3.0's Disk Mix tests reveal significant differences between the seven reviewed servers (the uppermost two curves) and the four that didn't meet our filter (the bottom curve).

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however, its slots are located at the top of the unit and face upward like those on a standard desktop, making them more accessible. Unlike the Dell system, the AST unit allows complete and easy access to the SIMM banks for simple memory upgrades, which is a plus.

The AST unit had average throughput compared with that of other tested systems. Performance was hampered by the installed Znyx Ethernet adapter; we found these cards to be poor performers on the whole. CPU utilization grew at a much higher rate than that of many of the other units after the system reached 12 users.

In anecdotal testing with an installed NIC from Cogent (which AST does not sell), the AST Manhattan's total throughput was boosted by 10 percent. In this case, CPU utilization was initially higher with the Cogent card than it was with the Znyx adapter. That situation was quickly reversed by the 4-client mark and CPU utilization leveled off so that with a full load of 15 clients, the AST system with the Cogent card had a CPU utilization that was 20 percent less than that of the same unit with the Znyx adapter.

AST Percepta, a Windows-based server-management package, incorporates a system diagram that lets you highlight an individual area of the server and then display that area and its installed components. AST Percepta also reports such crucial server information as system temperature and voltage, disk-array failures, and network-connection losses.

AST Percepta does not have a remote-notification feature, however; all alerts are displayed on the screen and logged to a file. For example, a temperature alert is displayed on the on-screen diagram of the system by a change of color from green to red in the overheated area (a color monitor is a necessity). If the network manager is not on-site to see the display, the temperature problem could result in a breakdown before any action can be taken. Compared with other proprietary packages such as IBM NetFinity, Version 2.01, HP's OpenView-based NetServer Assistant, Version 2.0, or Compaq Insight Manager, AST Percepta is limited as a total server-management solution.

AST goes the extra mile with a service and support plan that includes a three-year parts-and-labor warranty as well as on-site service for that same period. Telephone support is available 24 hours a day, 365 days a year, which is a welcome extra.

—William P. Flanagan

▶ FACT FILE

AST Manhattan G560

Estimated street price (as tested): $5,743 **Processor/memory:** Intel Pentium/60, 32MB RAM **Data storage:** Two 1GB Quantum Empire SCSI hard disks, NCR 810 hard disk controller with no cache, Philips LMS 215 CD-ROM drive **Network card:** Znyx ZX312 PCI **Power supply:** One 230-watt **In short:** The AST Manhattan G560 is a competitively priced, average performer backed by solid service and support. But while it does include a user-friendly, graphically oriented server-management software package, it lacks some valuable features, such as remote notification, which are found in offerings from Compaq, HP, and IBM

SUITABILITY TO TASK	
Ease of Setup/ Operation	EXCELLENT
Performance	GOOD
Expandability/ Scalability	GOOD
Security/Fault tolerance	FAIR

AST Research Inc., Irvine, CA, 800-876-4278, 714-727-4141, fax, 800-926-1278

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▶ SUMMARY OF FEATURES

File Servers

List price (tested configuration) The prices include server-management and quick-install software supplied with tested machines but not the cost of NetWare 3.12, which averages about $1,300 for a 15-user license and $2,000 for a 25-user license.

Modular hard disks come in individual chassis to facilitate removal and replacement.

Hardware or NOS **quick-install software** simplifies the installation process of hardware components or the network operating system.

Server monitoring describes various system features, such as disk subsystem, temperature, and network interface card that server-management software can monitor for errors and in order to tune for performance.

Management alerts describe the mechanisms the server can use to notify an administrator of situations that require attention.

Novell-certified for NetWare 3.x, NetWare 4.x indicates whether the vendor has put its servers through Novell's certification program.

Technical support via BBS, Internet indicates whether the vendor supports the product on a company bulletin board or on the Internet. **Technical support via AOL, CIS, Prodigy** indicates whether the vendor supports the product on America Online, CompuServe, and Prodigy.

Compaq Computer Corp.

• Compaq ProLiant 1000 Model 5/60-2100A

The $10,569 Compaq ProLiant 1000 Model 5/60-2100A, like the Compaq ProSignia 500 Model 5/90-2100 (reviewed separately), combines above-average performance with a unique and comprehensive array of hardware and software features, simple installation, and a three-year warranty with on-site service included. The ProLiant 1000, like the ProSignia 500, is targeted at the NetWare file- and print-server market, but the former is geared toward mission-critical applications while the latter is suited more toward general-purpose tasks. Compaq also sells ProLiants in dual- and quad-processor versions (the ProLiant 2000 and ProLiant 4000, respectively), but these machines are positioned as high-end application servers. Compaq positions the ProLiant 1000 and the ProSignia 500 in somewhat overlapping markets; the real differences between the two lines are more apparent at the next level of the ProLiant line.

This tower system has five removable hard disks that are hot-swappable, but the absence of PCI or other high-speed expansion bus slots could limit a growing network. (Compaq plans to ship a new model, the ProLiant 1500, that, among other im-

SUMMARY OF FEATURES

Workgroup File Servers

PC MAGAZINE EDITORS' CHOICE

Products listed in alphabetical order ■ = YES □ = NO	AST Manhattan G560	Compaq ProLiant 1000 Model 5/60-2100A	Compaq ProSignia 500 Model 5/90-2100	Dell PowerEdge SP590-2	HP NetServer 4/66 LC	IBM PC Server 300	Tangent Just'NCase SMP Workgroup Server
List price (tested configuration)	$5,743 (est.)	$10,569	$7,191	$9,193	$6,894 (est.)	$5,499	$7,754
Power supplies	One 230W	One 325W	One 240W	One 300W	One 200W	One 300W	Two 300W
Processor and Memory							
Processor	Pentium/60	Pentium/60	Pentium/90	Pentium/90	486DX2/66	Pentium/60	Pentium/90
Installed/maximum external RAM cache	256K, 256K	256K, 256K	256K, 256K	256K, 512K	256K, 256K	256K, 256K	256K, 512K
Installed/maximum system RAM	32MB, 256MB	32MB, 144MB	32MB,144MB	32MB, 256MB	32MB, 136MB	32MB, 192MB	32MB, 192MB
Occupied/total SIMM sockets	4, 4	4, 4	2, 4	2, 8	4, 6	4, 6	2, 6
RAM supports error correction	□	□	Optional	Optional	□	Optional	□
Expansion Buses							
Expansion-bus slots	3 ISA, 2 PCI, 1 PCI/ISA	7 EISA	3 EISA, 1 PCI, 1 PCI/EISA	5 EISA, 1 PCI, 1 PCI/EISA	4 EISA, 1 PCI, 1 PCI/EISA	5 EISA, 2 PCI, 1 PCI/EISA	3 EISA, 3 PCI, 1 PCI/EISA
Proprietary slots	None	1 modem, 1 RAM, 1 CPU	1 CPU	None	1 CPU	None	None
Parallel, serial, mouse ports	1, 2, 1	1, 2, 1	1, 1, 1	1, 2, 1	1, 2, 1	1, 2, 1	1, 2, 0
Disk Subsystem							
Number and capacity of installed hard disks	Two 1GB	Two 1GB	One 2GB	One 2GB	Two 1GB	Two 1GB	Two 1GB
Modular hard disks	□	■	□	■	□	□	■
Hard disk controller	NCR 53C810	Compaq Smart SCSI Array Controller	Integrated Compaq Fast SCSI-2/P	Integrated NCR 53C810	Integrated Adaptec AIC-7770	IBM Fast SCSI-2 PCI Adapter	Adaptec 2940
Hard disk controller cache	None	4MB	None	None	None	None	None
Accessible drive bays (5.25", 3.5")	3, 1	3, 5	4, 0	4, 4	4, 1	6, 2	6, 0
Internal drive bays (5.25", 3.5")	0, 3	0, 0	0, 4	0, 0	0, 0	0, 1	0, 2
Server Management							
Included server-management software	AST Percepta	Compaq Insight Manager	Compaq Insight Manager	None	HP NetServer Assistant 2.0	IBM NetFinity 2.01	Intel LANDesk
Price of included server-management software if purchased separately	No charge	$509	$509	N/A	$445	$599	$1,095
Quick-install software	□	■	■	□	□	■	Optional
Server monitoring	Voltage, temperature, hard disk subsystem, I/O statistics, model and serial number, memory configuration, network connection status	Temperature, power, fan functionality, disk or controller errors, disk degradation, CPU utilization, bus utilization, POST, UPS, user-set thresholds	Temperature, power, fan functionality, disk or controller errors, disk degradation, CPU utilization, bus utilization, POST, UPS, user-set thresholds	Temperature, power, fan functionality	Voltage, temperature, hard disk subsystem, bus utilization, network devices, network interface cards, POST, UPS	NetWare services, scheduling support, Windows services, power-on error analysis, predictive failure analysis,user and system information, user-set thresholds	Server status, applications in use, traffic, inventory of network resources, function of client workstation via remote control, printer queues, user-set thresholds
Management alerts:							
Local	Audible, LED	Audible, LED, monitor	Audible, LED, monitor	Audible	Audible, monitor	Audible, monitor	Audible, monitor
Remote	Console, SNMP	Console, printer, SNMP	Console, printer, SNMP	None	Console, printer, SNMP, trap alerts	Console, SNMP	Console, printer
Security and Serviceability							
Boot password	■	■	■	■	■	■	■
Lockable components	None	Case, front cover, power supply	Case	Case	None	Case	Case, hard disks, keyboard
Case opens without screwdriver	■	■	■	■	□	□	□
Service and Support							
Novell-certified for NetWare 3.x, 4.x	■■	■■	■■	■■	■■	■■	■■
Warranty parts/labor	3 years/3 years	3 years/3 years	3 years/3 years	3 years/1 year	3 years/3 years	3 years/3 years	3 years/1 year
On-site service	Included (3 years)	Included (3 years)	Included (3 years)	Included (1 year)	Included (3 years)	Included (3 years)	$295 (1 year)
Technical-support hours (eastern time)	24 hours, 7 days	24 hours, 7 days	24 hours, 7 days	24 hours, 7 days	9:00–8:00 M, Tu, Th, F; 9:00–6:00 W	24 hours, 7 days	10:00–9:00 M-F, 1:00–7:00 Sat.
Technical support via BBS/the Internet	■□	■■	■■	■■	■■	■□	■■
Technical support via AOL/CIS/Prodigy	□■■	■■■	■■■	■■■	□■□	□■□	□■□

N/A—Not applicable: The product does not have this feature

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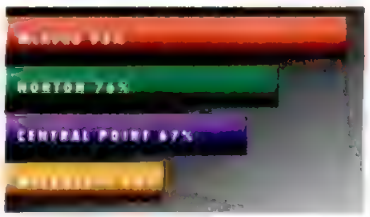

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CIRCLE 299 ON READER SERVICE CARD

provements, remedies this omission.) A well-integrated EISA-based motherboard, however, helps keep five of the system's seven EISA slots available for use. The two occupied slots contain a NetFlex-2 ENET-TR network interface card and a Smart Array SCSI controller card with 4MB of cache. The motherboard integrates a ZIF socket for the 60-MHz Pentium processor (by comparison, the ProSignia 500's CPU is on a separate processor card), along with the graphics chip set and four SIMM sockets that can accommodate up to 144MB of RAM (16MB are on the motherboard).

It's easy to get the ProLiant 1000 up and running, thanks to Compaq's SmartStart and its excellent on-line and printed documentation. To install a network operating system, you just boot up the system from the SmartStart CD-ROM and follow the directions. Compaq includes CD-ROMs for NetWare, OS/2, Microsoft Windows NT, and SCO Unix, among others; an activation key purchased from Compaq allows you to install the NOS of your choice.

The ProLiant 1000, in addition to the ProSignia 500 and Tangent's entry, the Just'NCase SMP, was among the best performers in the tightly grouped set of servers that we tested. While the ProLiant 1000's throughput matched that of those systems, however, its CPU utilization was higher at each client load. At the maximum of 15 clients, the ProLiant 1000's CPU utilization was 32 percent; the ProSignia 500's was half that at the same client load. It appears to us that the ProSignia 500's device drivers for its integrated PCI Ethernet controller are more efficient than those of the ProLiant 1000's EISA-based NIC.

Compaq also provides server-management capabilities through its Insight Manager, which is one of the most complete server-management packages in this roundup. Insight Manager's features include complete remote maintenance of your servers as well as local and remote notification. It also lets you reboot the server from a remote location or from any system on the network. It provides a full complement of control facilities, including diagnostics to analyze the condition of the server, system configuration, and updating of system firmware.

Compaq's service and support plan is competitive with that of the other vendors in this roundup, offering three-year

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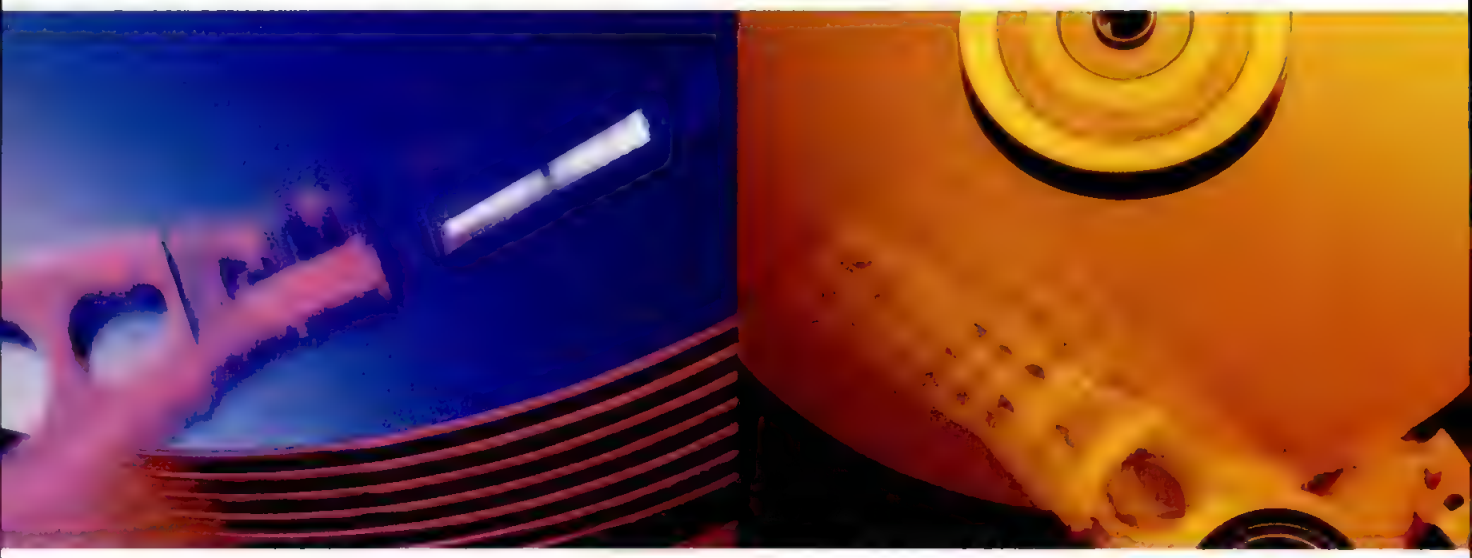

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CIRCLE 271 ON READER SERVICE CARD

▶ FACT FILE

Compaq ProLiant 1000 Model 5/60-2100A

List price (tested configuration): $10,569 **Processor/ memory:** Intel Pentium/60, 32MB RAM **Data storage:** Two 1GB Fast SCSI-2 hard disks, Compaq Smart Array controller with 4MB cache, CD-ROM drive **Network card:** Compaq NetFlex-2 ENET-TR EISA **Power supply:** One 325-watt. **In short:** The ProLiant 1000 is a well-designed—if expensive—system, but it doesn't fit in as a workgroup server as well as the Compaq ProSignia 500 does. The ProLiant 1000 is better suited to larger networks or those in mission-critical environments

SUITABILITY TO TASK	
Ease of Setup/ Operation	EXCELLENT
Performance	EXCELLENT
Expandability/ Scalability	EXCELLENT
Security/Fault tolerance	EXCELLENT

Compaq Computer Corp., Houston, TX; 800-345-1518, fax, 713-378-1442

489 on reader service card

coverage on parts and labor. The ProLiant 1000's warranty matches the best of the group, with three years of on-site service included.—*WPF*

Compaq Computer Corp.

EDITORS' CHOICE

Compaq ProSignia 500 Model 5/90-2100

The Compaq ProSignia 500 Model 5/90-2100 is an excellent choice for a workgroup server. This system provides a winning combination of solid hardware and software features, strong performance, and a competitive price of $7,191. Compaq's ProSignia line also includes the mini-tower ProSignia VS, which is a modified, entry-level version of the ProSignia 500. The ProSignia VS supports up to a 486DX2/66 and 128MB of system memory, whereas the ProSignia 500 can accommodate up to a 90-MHz Pentium and 144MB of RAM.

Compaq also sells the ProLiant series; the ProLiant 1000 Model 5/60-2100A is reviewed separately. The ProSignia 500 and ProLiant 1000 overlap a bit: Both are marketed as NetWare file servers, though the ProSignia 500 is suited more for general purposes while the ProLiant 1000 is geared toward mission-critical work. In many ways, however, the ProSignia 500 is superior in design to the ProLiant 1000: Both are tower units, but the ProLiant 1000's motherboard lacks PCI slots. The ProLiant 1000 also has no integrated network support, which may be beneficial in this class of server. The ProLiant line also includes the 2000 and 4000, which are dual- and quad-processor machines, respectively, aimed at the high-end application-server market; ProSignias are strictly single-CPU systems.

The ProSignia 500 is powered by a 90-MHz Pentium, which is mounted on a processor card that plugs into an EISA/PCI-based motherboard. The motherboard also has integrated graphics and Fast SCSI-2 hard disk controllers, as well as integrated networking support. The ProLiant 1000, in contrast, uses Compaq's NetFlex-2 network interface card and the Compaq Smart Array hard disk controller card. These cards are available as an option for the ProSignia line but were not included with the system we tested.

The ProSignia 500 was one of the top performers on our benchmark tests. Throughput remained above average at every client level, while CPU utilization remained very low.

Compaq's SmartStart makes server setup a snap. SmartStart is a set of CD-ROMs that eases the user through setup and installation of a surprisingly large number of network operating systems, including NetWare, SCO Unix, Microsoft Windows NT, and OS/2. It includes a setup disk and separate disks for each operating system. At start-up, you first choose which NOS you want to install (an activation code that you purchase from Compaq is required). SmartStart optimizes hardware and software configurations and attempts to eliminate installation errors by guiding you through the process with clear and concise directions and easy-to-access help menus. SmartStart is a standard feature on all of Compaq's servers except the ProSignia VS, where it is an option that we strongly recommend.

After the server is set up with the proper NOS, Compaq Insight Manager provides all the necessary tools for server

▶ FACT FILE

Compaq ProSignia 500 Model 5/90-2100

List price (tested configuration): $7,191 **Processor/ memory:** Intel Pentium/90, 32MB RAM **Data storage:** One 2GB Fast SCSI-2 hard disk, Compaq Integrated Fast SCSI-2/P hard disk controller with no cache, CD-ROM drive **Network card:** Integrated Compaq NetFlex-L ENET PCI **Power supply:** One 240-watt **In short:** The strong features and the great performance of the ProSignia 500, combined with its very competitive price, make this system an outstanding choice for a workgroup server.

SUITABILITY TO TASK	
Ease of Setup/ Operation	EXCELLENT
Performance	EXCELLENT
Expandability/ Scalability	GOOD
Security/Fault tolerance	GOOD

Compaq Computer Corp., Houston, TX; 800-345-1518, fax, 713-378-1442

490 on reader service card

management, including local and remote maintenance and notification. Insight Manager collects and monitors server data as well as data from each client and allows the network manager to act on it from a remote location or any workstation on the network.

The ProSignia 500 is backed by a comprehensive three-year warranty with three years of free on-site service.—*WPF*

Dell Computer Corp.

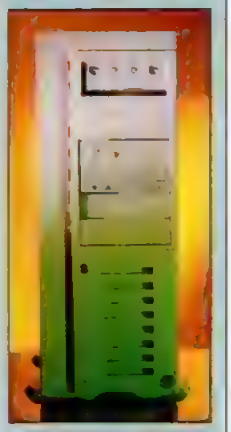
• Dell PowerEdge SP590-2

Dell's $9,193 PowerEdge SP590-2 provides a flexible solution for workgroup networks while still leaving room to grow. Built around a Pentium/90 CPU, the SP590-2 is part of Dell's PowerEdge line of servers. Although the PowerEdge series is designed for small- to medium-size networks, the systems can be upgraded to support larger networks.

Dell provides a free, optional service that will preconfigure the PowerEdge. All the user has to do is specify the NOS, network adapter, and memory and hard disk

▶ FACT FILE

Dell PowerEdge SP590-2



List price (tested configuration): $9,193 **Processor/memory:** Intel Pentium/90, 32MB RAM **Data storage:** One 2GB Seagate ST12550 Fast SCSI-2 hard disk, NCR 53C810 hard disk controller with no cache, NEC CDR-510 CD-ROM drive **Network card:** Novell/Eagle NE3200 EISA **Power supply:** One 300-watt **In short:** The Dell PowerEdge SP590-2's expandability and flexibility make it a viable solution, especially thanks to LANsolve, Dell's comprehensive service and support programs

Dell Computer Corp., Austin, TX, 800-274-3355, 512-338-4400, fax, 800-727-8320

491 on reader service card

SUITABILITY TO TASK	
Ease of Setup/ Operation	EXCELLENT
Performance	EXCELLENT
Expandability/ Scalability	EXCELLENT
Security/Fault tolerance	EXCELLENT

requirements and the unit will be shipped ready to go. This service is part of an optional suite of services called LANsolve. Dell will set up user accounts at no cost and, for an additional charge, arrange for complete network installation.

The PowerEdge's riser-board design positions the motherboard vertically in the tower while the riser board lays horizontally in the chassis. This design offers easy access to the motherboard from the top of the unit. The PowerEdge's system board has five EISA expansion slots and one PCI slot, plus one shared EISA/PCI slot.

The hard disk controller and graphics adapter are integrated, leaving seven usable slots. Memory upgrades are difficult because they necessitate the removal of the system board. This isn't a critical shortcoming, but it's worth considering if you expect your network to expand.

Dell offers an optional $1,899 Dell SCSI Array (DSA) controller board, which allows hot-swapping of SCSI hard disks. The PowerEdge came with a thermal monitoring board, which detects and notifies you, via a high-pitched beep, of excessive temperature in the processor or hard disk, as well as voltage variances in the power supply and any problems with the system's fan. This board is also offered as part of a bundle with the DSA board.

Though our setup did not have pager notification, this feature is provided by Dell's server-management software, SafeSite. SafeSite requires the DSA board, however, in order to make it operational.

SafeSite was released too late to review and ships only with DSA-equipped models, though you may purchase it for $499. It provides information on temperature, power, and DSA subsystem elements, and includes snap-in support for Intel LANDesk and HP OpenView.

The Dell unit yielded mixed performance results. Its CPU utilization scores were among the best in this roundup, but its throughput placed it last, just below the IBM PC Server 300. Like the IBM unit, the PowerEdge ships with a Novell/Eagle NE3200 EISA NIC, which may account for the similar throughput results.

Dell provides a three-year parts, one-year labor warranty with one year of on-site service included. For those who need more support, Dell offers Business Care Plus for $599, which extends on-site service to three years with a 4-hour response time.

—Padraic R. Boyle

Hewlett-Packard Co.

• HP NetServer 4/66 LC

The HP NetServer 4/66 LC, priced at $6,894 (estimated street price), was the only server we tested based on Intel's 486DX2/66 processor. Coupled with its EISA and PCI buses, however, the HP NetServer's performance was in no way inhibited. But even though the HP NetServer is upgradable to a 66-MHz Pentium via a processor board, expansion is limited by the total number of drive bays (five) in the chassis.

Hewlett-Packard is the only vendor in this roundup that does not offer its servers preconfigured with the choice of network adapters or preinstalled network operating systems. It does offer several different hardware configurations, and its VARs may offer further customization and other services to help you set up your server and network.

The HP NetServer, despite being equipped with a 486DX2/66 processor, displayed surprisingly strong results on our benchmark tests when compared with its Pentium-based competitors. Its good performance proves that processor speed isn't as important as the overall makeup of the system. Much of the HP NetServer's efficiency can be attributed to a combination of an integrated system board design, a high-speed I/O bus, and HP's 10/100VG EISA LAN adapter. Less of a surprise: The HP NetServer's CPU utilization was one of the worst in this roundup.

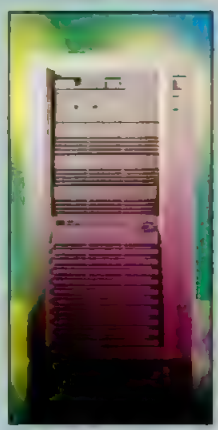
Similar to most of the servers tested, the HP NetServer provides an adequate mix of four EISA slots, one PCI slot, and one shared EISA/PCI slot. The 486DX2/66 processor may also be upgraded to a Pentium/66 CPU, but this move does incur a premium ($3,599), and by the time you need to upgrade the processor you may be more inclined to upgrade to a larger server.

One limitation of the HP NetServer is that it only has five drive bays, and in the configuration we tested, only one bay is left open. This doesn't leave you much room for growth if you want to add a tape-backup device or an extra hard disk.

NetServer Assistant, Version 2.0 (Version 2.1 is now shipping), HP's server-

▶ FACT FILE

HP NetServer 4/66 LC



Estimated street price (tested configuration): $6,894 **Processor/memory:** Intel 486DX2/66, 32MB RAM. **Data storage:** Two 1GB HP D2076B Fast SCSI-2 hard disks, integrated Adaptec AIC-7770 hard disk controller with no cache, Toshiba CD-ROM drive. **Network card:** HP 10/100VG EISA LAN adapter **Power supply:** One 200-watt. **In short:** The HP NetServer performed well and is nicely suited for a small to midsize workgroup, but it only has five drive bays, which limits expandability.

Hewlett-Packard Co., Santa Clara, CA, 800-322-4772, 800-533-1333, fax, 208-344-4809

492 on reader service card

SUITABILITY TO TASK	
Ease of Setup/ Operation	EXCELLENT
Performance	GOOD
Expandability/ Scalability	FAIR
Security/Fault tolerance	FAIR

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CIRCLE 379 ON READER SERVICE CARD

management package, is a $495 option with the NetServer LC series but was included with our test unit (the $6,894 price includes NetServer Assistant 2.0). NetServer Assistant is standard in the higher-end NetServer LF and top-of-the-line LM series; it definitely deserves a closer look if you're interested in management tools. Based on HP's management platform, OpenView, NetServer Assistant provides extensive statistics on system temperature, disk capacity, bus utilization, and network interface boards while also providing early warning notification via pager, e-mail, and on-screen messages. (To take advantage of features such as paging you need the $999 Remote Assistant board, which has a modem.) NetServer Assistant is very similar to IBM's server-management software, NetFinity, but with a much broader spectrum of available services.

HP provides an extensive warranty, including three-year on-site parts and labor service with next-day response. Support programs can also be upgraded to a 4-hour response time in most regions at an additional, negotiable cost. Toll-free technical support is also available during extended business hours (not including weekends). Additional support from HP is offered via a BBS or CompuServe, as well as over the Internet.—*PRB*

IBM Personal Computer Co.

• IBM PC Server 300

IBM Personal Computer Co. continues its aggressive push into the networking market with its $5,499 60-MHz Pentium-based PC Server 300—a product that, for the first time in IBM's history, uses a third-party Micronics motherboard and eschews IBM's proprietary Micro Channel architecture (MCA). A competitive performer with superb network-management capabilities, the inexpensive PC Server 300 has plenty to recommend it.

IBM still plans to ship MCA, both with and without PCI, in its PC Server 500 series. These servers are higher-end, enterprise-wide file and application servers.

Like Dell, IBM will customize and preconfigure servers complete with network

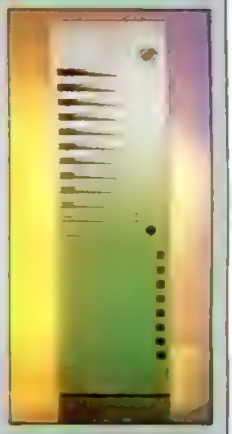
FACT FILE

IBM PC Server 300

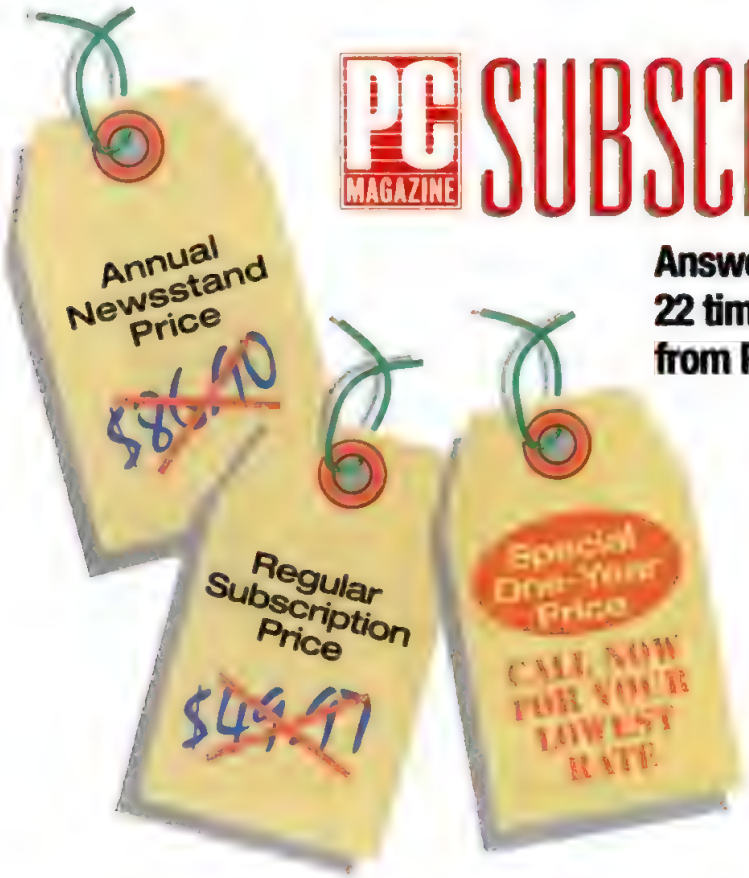
List price (tested configuration): $5,499 **Processor/memory:** Intel Pentium/60, 32MB RAM **Data storage:** Two 1GB IBM 0662S12 SCSI-2 hard disks, IBM Fast SCSI-2 PCI adapter hard disk controller with 256K cache, IBM CD-ROM drive **Network card:** Novell/Eagle NE3200 EISA **Power supply:** One 300-watt **In short:** The IBM PC Server 300 was a solid contender in our roundup. Though not the best performer, it is well equipped and very inexpensive

IBM Personal Computer Co., Somers, NY, 800-772-2227; fax, 800-426-3395

483 on reader service card



SUITABILITY TO TASK	
Ease of Setup/Operation	EXCELLENT
Performance	EXCELLENT
Expandability/Scalability	EXCELLENT
Security/Fault tolerance	FAIR



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CIRCLE 186 ON READER SERVICE CARD

operating system, network adapters, and custom memory and hard-disk configurations. By comparison, Compaq ships SmartStart with its servers, leaving the software installation up to the network administrator.

The PC Server 300's system board comes with five EISA slots, two PCI slots, and one shared EISA/PCI slot for a total of eight usable slots. One slot was occupied by a graphics card and another by the SCSI-2 card in our test system. The slots are easily accessible from the side once the cover is removed. Two of the EISA slots cannot support a full-length expansion board, however, because of a protruding processor heat sink. To its credit, IBM's system documentation is thorough enough to note even this minor limitation.

IBM's server-management software, NetFinity, Version 2.01, comes with the PC Server 300. NetFinity supports many high-end server- and workstation-monitoring features. Some of the features that top this list are SNMP (Simple Network Management Protocol), remote management, support for OS/2, support for NetWare 3.1*x* servers and Microsoft Windows 3.1 clients, and the ability to send alerts to a pager in the event of a failure (provided you have a modem connected to the system). Similar products are available from Compaq and Hewlett-Packard.

The PC Server 300's case offers nine drive bays. The front cover can be locked with a key, which disables access to the drive bays and secures the cover onto the chassis. The front cover will not stay closed if it is not locked, however, and tends to swing open, requiring you to either keep it locked at all times or to remove the door from the system altogether.

Anticipating that the PC Server 300 may be stored in an unsecured environment, IBM offers an optional U-bolt on the back of the PC Server 300's chassis. This enables you to secure the server to any piece of furniture with a cable-locking device. IBM has also licensed a copy of DiagSoft's QAPlus/PRO, Version 5.2, a systems diagnostic program, and integrated it into NetFinity to assist you in troubleshooting any possible conflicts or hardware problems.

There are clear trade-offs with the PC Server 300's performance. Its CPU utilization results were among the best in our roundup, but its throughput scores were below those of many systems in this elite group.

IBM offers a three-year warranty (with 4-hour on-site response time) and provides extensive toll-free technical support (24 hours a day, 7 days a week, 365 days a year) as well as support via CompuServe and a via a company bulletin board system.—*PRB*

Tangent Computer Inc.

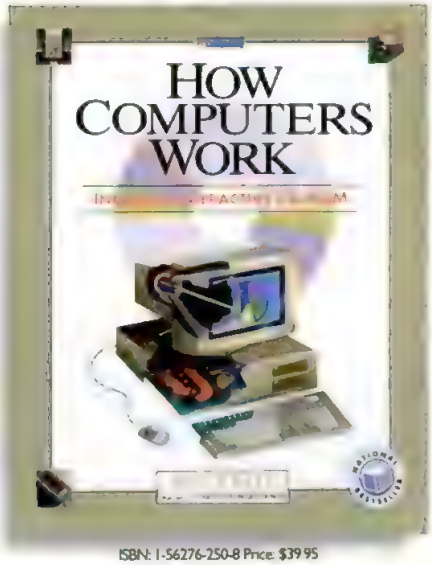
• Tangent Just'NCase SMP Workgroup Server

The $7,754 Just'NCase SMP Workgroup Server from Tangent Computer offers all the trappings of a well-designed workgroup server, from its basic design to its thorough documentation and its third-party server-management software. It was also one of the best all-around performers of this roundup.

Tangent distributes the system direct-

Click Click.

PC/Computing How Computers Work CD-ROM/Book extravaganza from Ziff-Davis Press.



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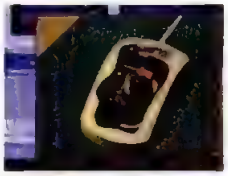

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ly as well as through resellers and pre-installs NetWare, which eases the installation burden. For an additional $395, Tangent's Platinum Install procedure includes preloading of applications and labeled cabling for individual workstations; the company will also set up passwords and print directories for workstations upon customer request. A customer who owns the applications can send them to Tangent for installation, or can buy them from Tangent instead. Through the Platinum Install procedure, Tangent can use information supplied by the customer to also set the rights and authorizations of individual users. The company included Intel's server-management software, LANDesk, with our test system, although buyers can choose whichever package they want or none at all. The documentation, which is specific to this server, is one of the most comprehensive of any system in this roundup, providing plenty of information on fault tolerance, maintenance, and server troubleshooting as well as technical reference data on the unit's motherboard, hard disks, and other individual components.

FACT FILE

Tangent Just'NCase SMP Workgroup Server

List price (tested configuration): $7,754 **Processor/memory:** Intel Pentium/90, 32MB RAM **Data storage:** Two 1GB Seagate ST31200 Fast SCSI-2 hard disks, Adaptec 2940 hard disk controller, NEC CDR84 CD-ROM drive **Network card:** Cogent eMaster+ EM964T PCI **Power supply:** Two 300-watt **In short:** The Tangent Just'NCase SMP Workgroup Server has all the qualities of a good workgroup server good design, strong performance, a well-rounded bundle of management features, and complete service and support programs

SUITABILITY TO TASK	
Ease of Setup/ Operation	GOOD
Performance	EXCELLENT
Expandability/ Scalability	EXCELLENT
Security/Fault tolerance	FAIR

Tangent Computer Inc., Burlingame, CA, 800-800-5550, 415-342-9388, fax, 415-342-9380

494 on reader service card

On our performance tests, the Just'NCase SMP was among the best of the group, along with Compaq's ProLiant 1000 and ProSignia 500. Using a network interface card from Cogent, the Tangent unit's throughput climbed steadily as clients were added and its CPU utilization results, which peaked at 23 percent with 5 clients, actually dropped slightly as more clients were added, finishing at 20 percent with 15 clients.

The Just'NCase SMP is also designed well physically. The machine's 90-MHz Pentium processor is on an EISA/PCI-based motherboard that includes a second ZIF socket for multiprocessor support and can accommodate up to 192MB of system memory. All components are accessible with the cover off; memory can be easily upgraded and the expansion slots are free from excessive cabling. There are also two hot-swappable, modular hard disks installed in the system for easy maintenance of the disk subsystem. These disks have individual locks on them for security, as does the main case itself. The Just'NCase SMP also comes with two 300-watt power supplies, which are redundant and also hot-swappable.

Some of these features—like the dual-processor capability and the redundant power supplies—may be overkill in a server of this class. Then again, they don't seem to add much to the unit's price.

Monitoring of the server status and client workstations is handled by Intel LANDesk. This package has features that include local notification through an alarm and/or on-screen warnings as well as remote notification through a beeper or a pager with a modem installed (a 14.4-kilobit-per-second modem costs an additional $139).

Tangent's in-house labs and support personnel are Novell-certified, and they test all systems prior to shipment. Tangent provides a three-year warranty on system parts and a one-year warranty on labor. On-site service costs vary depending on what kind of service the customer requires: A 4-hour response time costs $495 for one year, while a 24-hour response time is $295 per year. In addition to the toll-free number, technical support is available through Tangent's private bulletin board as well as through CompuServe and the Internet.—*WPF*□

Network Edition

PC NETWORK EDITION MAGAZINE

The latest network products and management techniques

First Looks

NFS SERVERS

A Universal Language for Your Network

Unix clients can "talk" to Windows NT server resources.

By O. Ryan Tabibian

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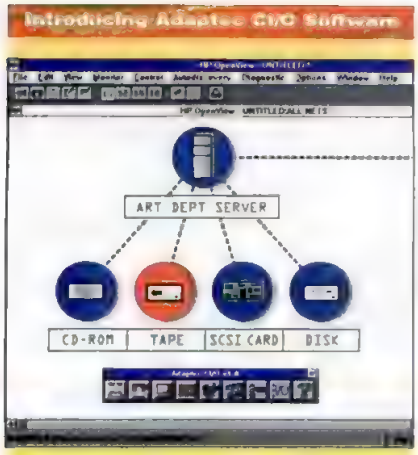

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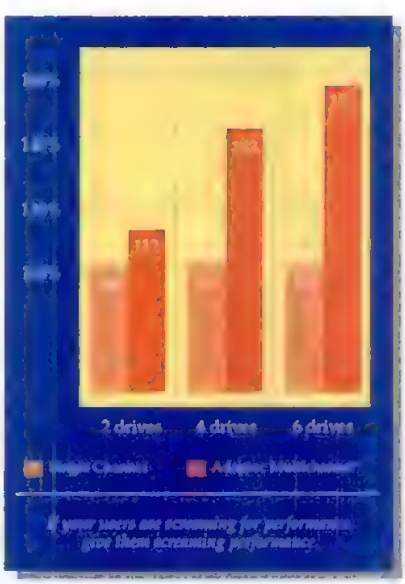

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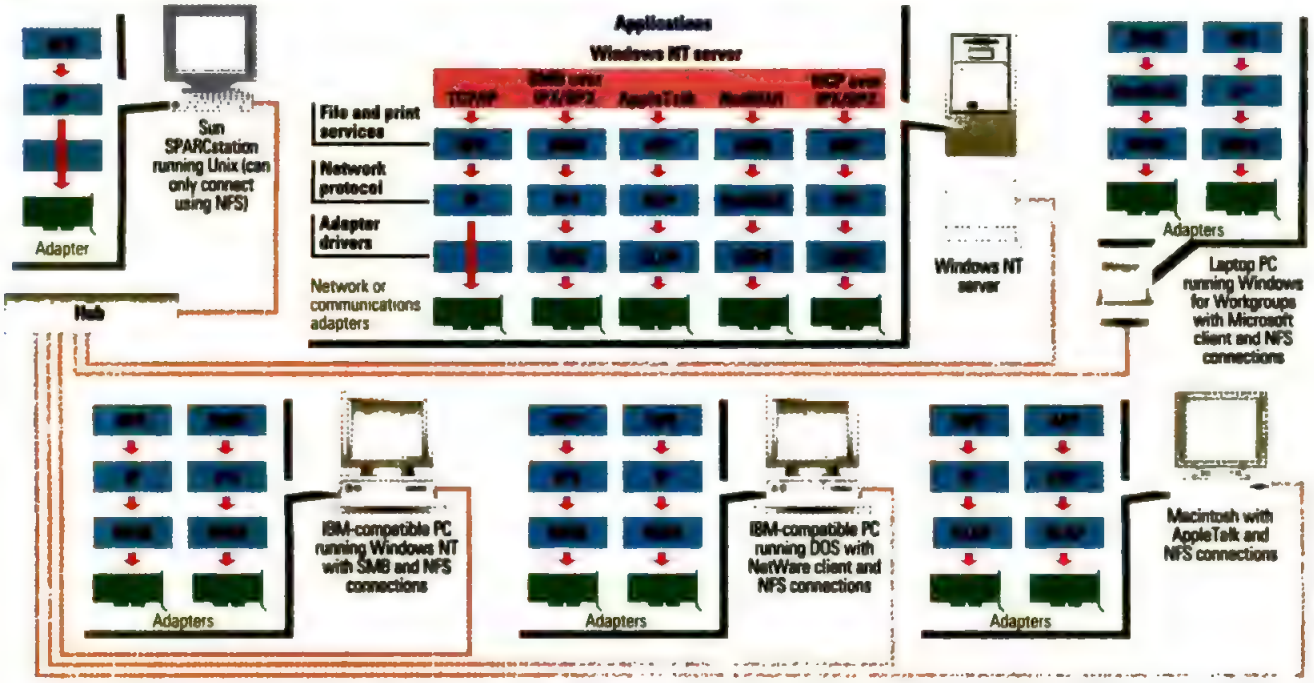
CIRCLE 934 ON READER SERVICE CARD

MAKING WINDOWS NT A UNIVERSAL SERVER

Microsoft Windows NT can act as a nearly universal server for all kinds of clients: NetWare, Unix, Windows for Workgroups, and Windows NT. The NetWare Core Protocol (NCP) service for Windows NT is a newly announced Microsoft product. The NetBIOS/NetBEUI combination and Server Message Block (SMB) are standard Microsoft networking services. IPX, originally Novell's networking protocol, is standard in Windows NT, as is AppleTalk.



ing palatable solutions for dealing with that ugly truth. This roundup is a case in point. We installed and tried out three software packages that sit on your Windows NT server and let most clients (including Unix clients) access shared file and print resources using a single protocol: the Network File System (NFS).

The packages are NetManage's Chameleon32NFS 4.01, Intergraph Corp.'s DiskShare for Windows NT 1.0, and Process Software Corp.'s NFSware for Windows NT 1.0. (Beame & Whiteside Software should have a product out by the time you read this.)

NFS was originally designed to provide connectivity among different Unix platforms. In this new role, it offers the strength of a robust protocol that can be used on the majority of client platforms. There's one drawback: At least right now, some of your users may take a noticeable performance hit when accessing shared resources. That's the trade-off for being able to handle just one *robust* protocol.

NFS is part of TCP/IP. Its appeal has widened since it has become available as both client and server software on a majority of OSs, including Microsoft Windows, OS/2, and Mac. NFS is still found almost exclusively in Unix environments, but its usage should increase with the numbers of PC clients that run TCP/IP. According to International Data Corp., the shipment of PCs running IP increased 103 percent over last year.

Under NFS, any client running NFS software can mount shared server vol-

DiskShare for Windows NT, Version 1.0

As performance of these products is about equal, it certainly is not a driving force in choosing one. We focused on other factors in designating DiskShare for Windows NT our Editors' Choice. DiskShare offers the most attractive mix of features, many of which are built on its tight integration with Windows NT's File Manager. For example, it prompts users who want to share files to indicate whether they want to share for Windows NT or NFS clients. It also has a nice statistics-gathering tool and good export capabilities.

DiskShare has a good Windows interface, which is a real help considering it also offers you quite a bit of tuning flexibility. Tuning capabilities are important in adjusting the number of threads that the application can use.

Chameleon32NFS was a close second. It doesn't offer as many features as DiskShare, but it was simple to configure. And it does include a full suite of TCP/IP tools. Chameleon also requires the least Unix knowledge of the three.

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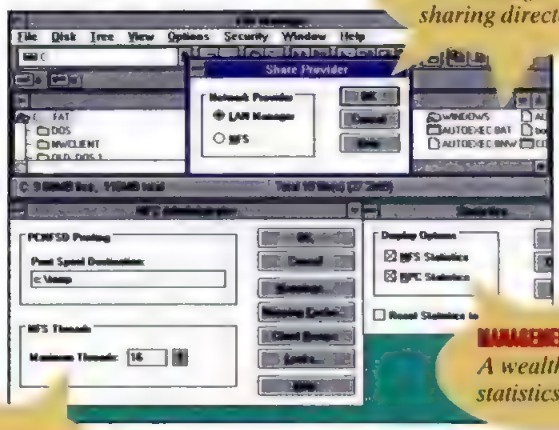
umes and print to any printer on the network. Unlike the File Transfer Protocol (FTP), in which you can access only directories on other systems, NFS allows you to redirect remote drives locally to share files. Think of NFS as the Esperanto of computers: Esperanto promises a universal language, enabling communication among people of different tongues. NFS promises a single protocol under which all computers on your network communicate with each other.

In this roundup we visit a relatively new sector of the market: NFS server products that run on Windows NT 3.5 servers. These packages all complement the built-in TCP/IP stack of Windows NT servers and add only the NFS server portion. This new set of products offers some impressive features. Leading the way was DiskShare, with excellent management tools and an intuitive graphical interface.

DISKSHARE'S GOOD UI: *Good use of Windows for putting NFS on your server.*

WINDOWS NT INTEGRATION: *Tight connection with File Manager when sharing directories.*



MANAGEMENT: *A wealth of statistics options.*

TUNING PARAMETERS: *Simple but complete and flexible tuning options.*

THE NFS BREAKDOWN

The NFS market for Windows NT products breaks into three segments: multiplatform environments that want to standardize on a single protocol; sites that want to publish and share information on, for example, CD-ROMs that reside on an NT server; and sites that are looking for a way not only to integrate Windows NT into their existing network but to provide a migration path from Unix to Windows NT.

If you're looking to standardize on a single protocol, NFS is a good choice. You'll forfeit performance, but it is extremely robust, and client and server software is available on virtually every platform. NFS even offers some security, with data encryption and user authentication; it is, however, not the same level of security as with other NOSs, such as NetWare. And NFS runs on top of TCP/IP, an advantage for companies that have standardized on IP.

For another segment, Windows NT is an inexpensive, easy-to-use server platform for making information available to all clients. Companies looking to share CD-ROMs and databases will find that NFS on Windows NT provides a cost-effective solution to publishing on-line.

A final segment of users looks for a simple method of integrating Window NT servers within a Unix environment. Although Windows NT offers a potpourri of protocols, including AppleTalk, IPX, and TCP/IP, currently there is no way aside from FTP to provide full access to Unix clients. The answer is NFS.

THIS NFS IS FOR YOU

We focused our reviews in three areas: scalability, management, and ease of use. A scalable product should be a true 32-bit multithreaded application to exploit Windows NT features fully. To improve performance, you increase the number of

Put Out the Fire Before It Starts

How do you keep intruders from accessing your NFS server or other IP-based applications? There are a number of things that you can do to make your server safe.

NFS is not considered an inherently secure system. But some security features built-in to NFS products, such as encrypted passwords, make NFS more secure than other IP-based applications. FTP and telnet, for example, are less secure because they echo all keystrokes across the network. Any network-savvy eavesdropper with a protocol analyzer can pick up the log-on name and password of network users, since those keystrokes are not encrypted.

But there are other things you can do to keep your IP-based applications secure. Depending on the level of security you need, you can deploy a router or, for an even higher level of security, set up a *firewall.* In basic terms, routers use IP-address access lists to enforce security, whereas firewall software and hardware can filter at the packet level, providing tighter checks on intruders.

All IP-based applications run over a designated Unix port number. For example, FTP runs over port 21. Router-access lists let you filter on a range of port numbers. This means you can restrict access of specific port numbers from outside users. The current standard practice is to filter all ports below number 1,024. Still, people can get around such measures, since all port numbers are configurable. For example, by assigning FTP to run over a higher port number, such as 8,000 (which does not get filtered), they can easily breach your security.

A firewall provides a wealth of security features above and beyond what a standard router can offer. Especially if your network is to be connected to the Internet, a firewall is a must in order to keep intruders out.—*ORT*

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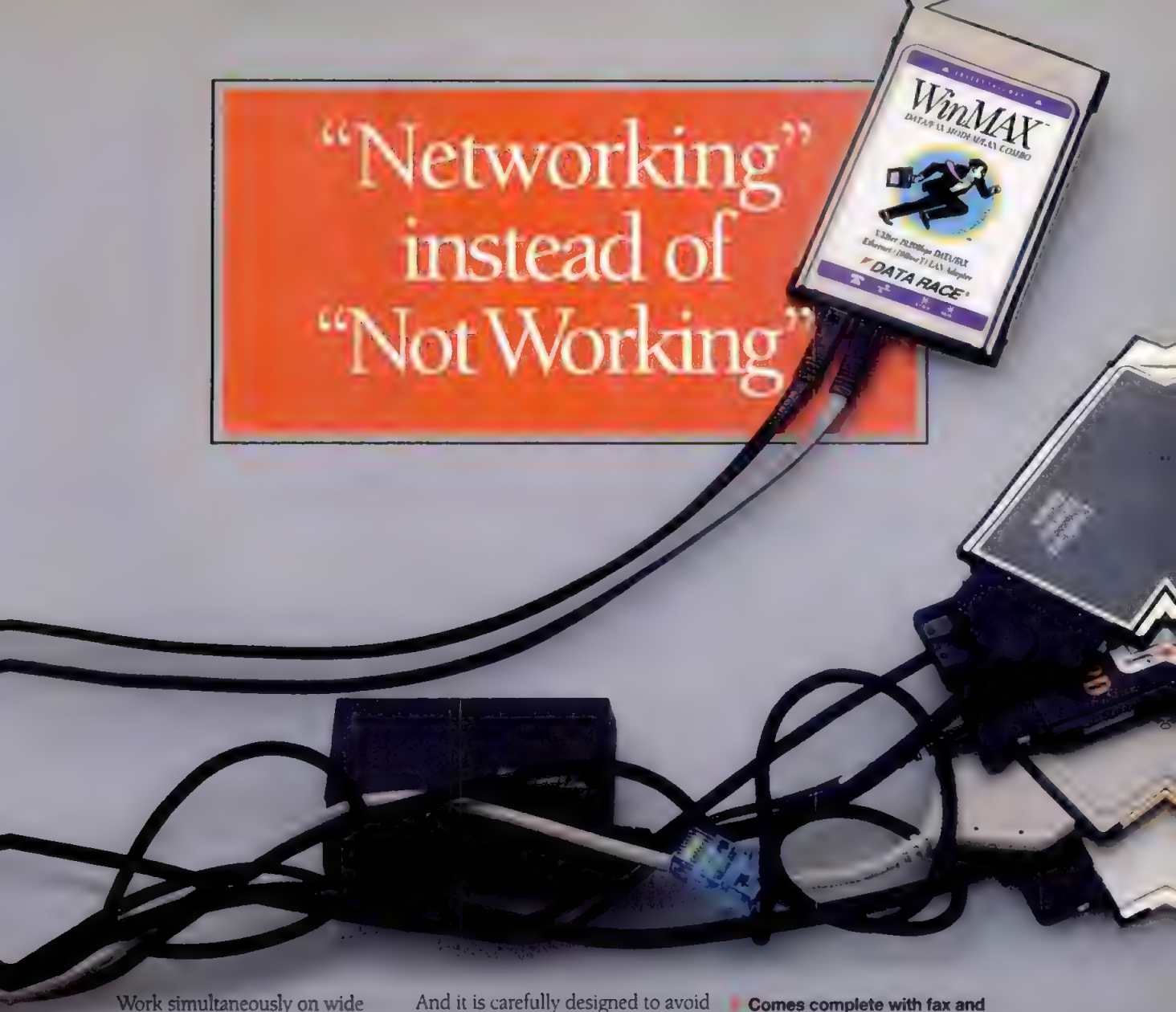

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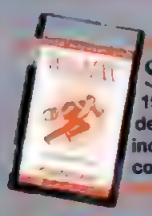

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NetWare Directory Services. Access and view your entire network at a single glance.

The previous generation of networks only let you view the network one server at a time. They weren't exactly convenient. But with NetWare 4.1, it's different. You get a complete view of the network. It's the only network that allows users to login once and access any file, document or resource for which they're authorized. Even better, administrators can manage the network from a single-point-of-administration. That means you avoid the hassle of managing your network server by server, managing it instead as a single entity.

Conveniences like these can save you a whole lot of time and money.

NetWare Messaging Services. The simplest way to manage your E:mail users.

In the past, messaging required a separate purchase, a separate installation, and a separate database. With NetWare 4.1, everything is a lot simpler. That's because integrated messaging built into NetWare 4.1 works with almost any E:mail front-end application. There's no additional mail software needed. And, it's integrated with NetWare Directory Services, so network and E:mail administration can be accomplished through a single-point-of-administration. It's a lot simpler, and a lot easier.

NetWare Multiprotocol Routing. Get your data from point A to point B.

Getting connected to other networks usually means buying separate hardware. But with NetWare 4.1, multiprotocol routing comes built-in. And because NetWare's Multiprotocol Routing supports IPX, TCP/IP, Appletalk and others, it connects networks without the need for additional hardware. And not buying all that extra hardware can add up to big savings. And who could possibly be against big savings?

NetWare Network Management. Easily the most manageable network.

NetWare 4.1 offers unmatched management and administration

capabilities. For example, it allows you to take full control of any server from anywhere on the network. It also has a new graphical user interface that lets you manage the network as a single entity, instead of a collection of separate servers. So jobs that used to take hours can be accomplished in minutes. Plus, tasks like setting up users, granting security privileges and access to resources—tasks that were very time consuming with NetWare 3—aren't with NetWare 4.1. Click a few icons, then type information in a dialog box. You've just added another user to the entire network. It's quick and easy. Again—saving you time and money.

NetWare 4.1 Security Services. Simply the industry's most secure NOS.

One of the greatest concerns about any network operating system is how secure it is. NetWare 4.1 includes RSA security, the industry's most secure password encryption and digital packet signature technology. In fact, it was designed to meet the National Computer Security Center's Class C2 Network Security criteria. Look. If you can't afford to have confidential data in the wrong hands, that's reason enough to upgrade to NetWare 4.1 today.

NetWare 4.1 File Services. We just improved on perfection.

NetWare 4.1 shares the same industry leading file system as NetWare 3, except it also comes with terrific, industry leading enhancements. There's a server-based file compression feature that can double the size of the hard drive, leaving more room for data. And sub-allocation provides more efficient storage. It also provides optional large block sizes which speeds data transfer performance from hard drive to memory. And data migration reduces storage media costs by transparently migrating data to near-line or off-line storage. You know, this is a great way to avoid having to shell out the big bucks for more space later.

NetWare 4.1 Print Services just got smarter.

With NetWare 4.1, you can say goodbye to printing nightmares for good. NetWare 4.1 provides the most robust set of print services in the industry. It's terrific. For example, you don't need to know anything about the print server. All you need to know is the name of the printer and you're set. That's it. Plus, NetWare 4.1 Print Services maximizes your hardware investment because it allows up to 256 printers to run off one server (as opposed to NetWare 3, which limits you to 16 printers). Just think how much time, money, and hours of frustration this could save you.

7 Key Services	NetWare 4.1	NetWare 3
❶ DIRECTORY Global directory service	YES	NO
❷ INTEGRATED MESSAGING	YES	NO
❸ MULTIPROTOCOL ROUTING	YES	Add-on product
❹ NETWORK MANAGEMENT Graphical user tools provide view of entire network	YES	NO
❺ NETWORK SECURITY		
RSA public/private key	YES	NO
Restrict login to specific Mac address	YES	NO
Security auditing	YES	NO
❻ FILE SYSTEM AND STORAGE Support for data-migration hardware, data compression and disk block suballocation	YES	NO
❼ NETWORK PRINTING	256 per print server	16 per print server
Additional Services		
• INTEGRATED SYSTEM FAULT TOLERANCE LEVEL III	YES*	Add-on product
• CLIENT SUPPORT AND INTEROPERABILITY		
NetWare for Macintosh, Number of user licenses included	Included in Netware user licenses	5
Graphical user tools	YES	NO
• WAN SUPPORT Network link Service Protocol™ (NLSP)™	YES	Add-on product
• ARCHITECTURE		
Maximum number of user connections per server	1,000	250
Nondedicated server	YES**	NO
Single login to network	YES	NO
Addrtve licensing	YES	NO

NetWare Return on Investment. It makes sense on your bottom line.

NetWare 4.1 has the lowest cost of ownership in the industry. In fact, the META Group reports NetWare 4.1 can cut 25%† from the cost of managing a network. Think of it. That means your NetWare 4.1 upgrade or new purchase will virtually pay for itself in no time. Here's a chance to make the accountants smile for once.

NetWare 4.1. All this and much, much more.

NetWare 4.1 also comes with everything you need to run your network on TCP/IP, so you can run IPX or TCP/IP throughout your network. It also has built-in support for your Macintosh users. And built-in System Fault Tolerance level III capabilities. (To activate this service, all you have to do is simply purchase a license disk and you can reduce the chances of network failure to almost zero. And because it's built-in, there's no need to reload your system).

Still, we know all these features wouldn't mean diddly if they didn't work right out of the box. So we submitted NetWare 4.1 to rigorous testing—first we tested it at Novell labs, then the press took a crack at it, and finally, our toughest customers got their chance. It passed with flying colors. Without a doubt, NetWare 4.1 is set to take center stage in the industry.

We hope we've told you enough to get things underway. But in case you need more information about NetWare 4.1, just call Novell at 1-800-844-6661 or dial us in at http//www.netware.com. We'll do everything we can to help.

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NetWare 4.1

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threads for the application, a feature offered by all three products.

Within scalability, consider that NFS was not designed for performance, so you need a product that is highly tunable. Tunable means being able to adjust variables, such as the maximum number of threads that the product uses, cache size, and protocol-timing parameters. NFSware offered the greatest number of tuning parameters, but it was also the most difficult to use and configure.

Management is always important. We considered the level of features and functionality offered in sharing and exporting directories, managing resources, and sending alarms. DiskShare offered the best level of management, but it was followed closely by the other two.

Ease of use is also an important consideration. Why should an add-on package be any tougher to use than your server software itself, especially if it's supposed to be solving a problem. We looked at the integration with Windows NT and Windows NT's File Manager, the intuitiveness, and overall approachability.

One of these NFS server products could be just what you need. Be sure to do a full assessment of your environment and your plans before you take one on.

NetManage Inc.

• Chameleon32NFS

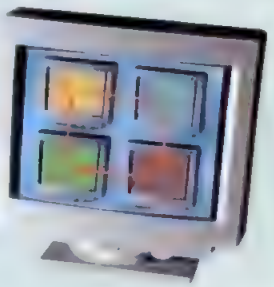
By far the simplest product to install and configure of the three, Chameleon32NFS 4.01 also performed comparably with the other products. NetManage is a veteran in the PC-to-Unix connectivity market, so it was a natural to offer an NFS server product for Microsoft Windows NT. In fact, NetManage offers a full suite of native 32-bit Windows NT TCP/IP tools such as FTP and Gopher. In this review, though, we focus on the NFS server portion.

Although Chameleon might not be the most feature-rich product reviewed, we installed and configured it in less than 10 minutes. We can't say this about the other products here. In addition, this product requires little understanding of Unix for a

■ Novell's Answer to NFS

By Russ Iwanchuk

Are you looking for a product that will integrate NetWare 3.*x* or 4.*x* along with your Windows NT server in a multiplatform environment? If so, look no further.



Novell's NetWare NFS, Version 1.2c, does the trick, albeit at a rather pricey $4,995. It offers the full Network File System (NFS) protocol over TCP/IP with other features, such as FTP, telnet, and Unix print services. Like the reviewed products, it allows Unix and other NFS clients to connect and map a NetWare volume using NFS over TCP/IP rather than via the native NCP over IPX.

NetWare NFS has many file-sharing services to recommend it. For starters, you can map any NetWare volume to the file system of any NFS client. All NFS clients can access file and print services, not via IPX but via IP using NFS. NetWare NFS also lets NFS clients access files on other NetWare servers on the network even if they are not running NetWare NFS.

As for print services, you can make NetWare printers available to non-NetWare computers that use the line printer daemon (LPD) protocol and printers attached to non-NetWare computers that use the LPD protocol available to computers on the NetWare network. NetWare NFS also features remote console access, so Unix clients can use all the NetWare server-console functions via X Windows.

To top it off, NetWare NFS offers an intuitive installation. We installed the product in about 15 minutes with little trouble. It includes a simple but feature-rich administrative utility for setting up NFS users and exporting NetWare directories to be used by NFS clients.

It comes at a hefty price, but we found NetWare NFS to be a good tool for implementing NFS on your NetWare server. □

Suitability to Task: NFS Servers

If you need one of these NFS packages for Microsoft Windows NT servers, you've already got enough complications. You don't need the software to introduce any more. As with any kind of add-on product, you're looking for it to do its job, but also to fit in with the software you've already got running. We looked at three key areas that target these packages' value to the busy network manager. If you've got Unix clients, one is right for you.

A good NFS server for Windows NT should offer **scalability.** It should include excellent tuning capabilities that allow you to adjust everything from the number of threads for applications to the amount of cache allocated for the NFS service (especially since NFS was not designed for performance). It should run as a native 32-bit Windows NT app to take full advantage of multithreading and multiprocessing

SUITABILITY TO TASK	
Product Name	
Scalability	FAIR
Management	GOOD
Ease of use	EXCELLENT

In evaluating **management,** we consider administration and configuration tools for managing the server and tuning it to fit your environment best We look at the level of features and functionality offered in the sharing and exporting of directories, managing resources, and sending alarms to the administrator. We also note levels of security offered. This includes the server's ability to take advantage of built-in Windows NT security features, such as NTFS, as well as other NFS-specific measures, such as PCNFSD authentication.

Ease of use is essential. We look for it in three areas: installation, configuration, and management. We strongly consider the user interface and the documentation quality. These are products designed to work with Windows NT: Their capabilities should be easy to figure out.

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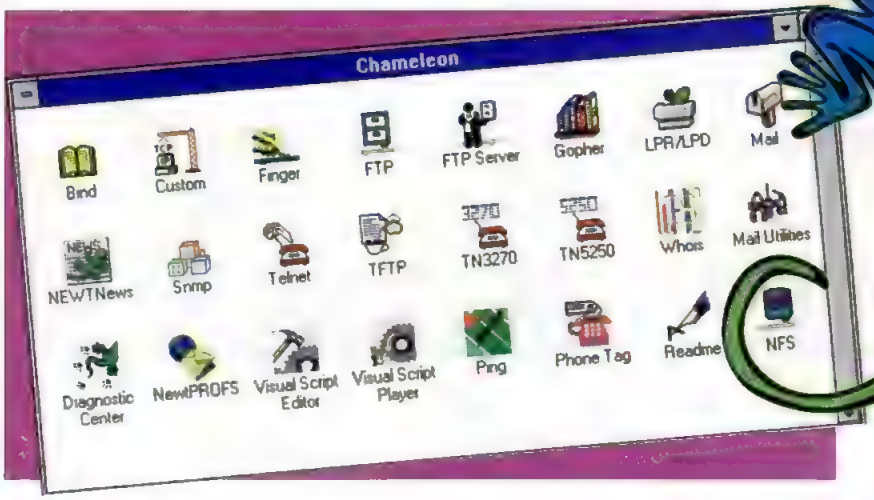

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Chameleon includes more applications that allow you to access information on Unix, mainframes, minicomputers, PC-based LANs and WANs, and the Internet.

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Connect to your network and the Internet via LAN or dialup access with one easy-to-use software package. Send and retrieve email, download files, print documents, login to remote hosts, and run client/server applications. Connect your PC to the world with Chameleon.

NetManage Chameleon includes WinSock TCP/IP and is 100% DLL. Chameleon requires only 6KB memory and installs in just 5 minutes.

APPLICATIONS INCLUDED:

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  - Visual Script Editor & Player
- File Transfer
  - FTP Client & Server
  - TFTP
- File & Printer Sharing
  - NFS Client & Server
  - LPR/LPD
- Electronic Mail
  - SMTP Mail with MIME
  - Phone Tag
  - IBM PROFS
  - POP2, POP3, SMTP
- Internet Access
  - Gopher
  - Newsreader
  - Whois
- Network Utilities
  - Ping
  - Finger
  - Diagnostic Center/Trace Agent
  - DNS Client & Server
- WinSock TCP/IP
  - 100% DLL TCP/IP Stack
  - Windows install and setup
  - LAN: Ethernet, Token Ring
  - Dialup: SLIP, CSLIP, PPP & ISDN

Sept.1994 Sept.1994 Sept.1994

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Benchmarks Tests: NFS Servers

To shops with Unix clients and Microsoft Windows NT servers, the benefits of these NFS servers will outweigh the performance difference seen when they are pitted against native IPX.

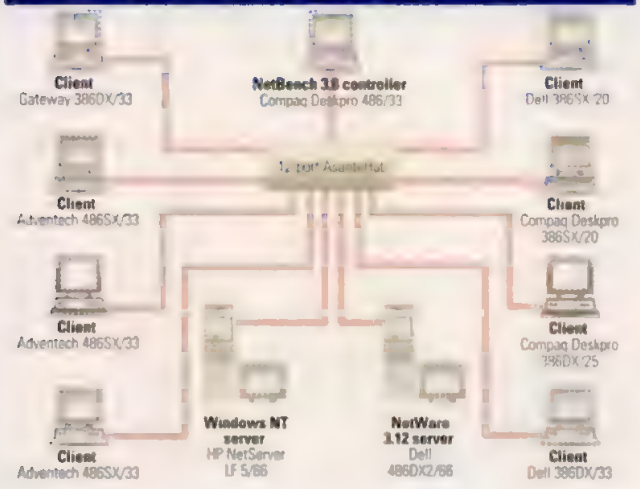
NFS is a slow protocol. But the differences we observed will be secondary to shops with Unix machines that would like to standardize on one protocol.

We used the **Disk Mix** portion of NetBench 3.0 to test the I/O throughput of these NFS products. The Disk Mix test allocates 20MB of hard disk space on the server for each client, then randomly executes open, close, read, write, and update actions of the files on the server. Files were moved across the network using 1K block sizes.

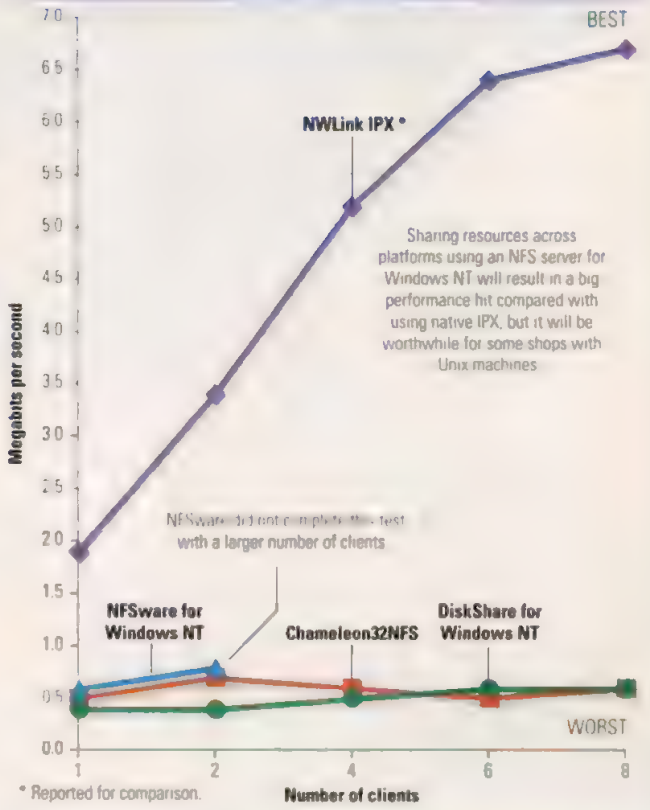
For comparison, we also ran the test using the native NetWare IPX protocol (NWLink) to assess the difference in performance between NFS and native IPX under Windows NT.

On our test-bed, all clients were running IP and IPX concurrently. All clients had to maintain a connection to the NetWare server in order to receive the path for the NetBench data files. The NetWare server was not part of the benchmark test, since all the clients sent requests to the NFS server, which was running Windows NT 3.5. We used the NetBench 3.0 controller to initialize the test and gather the test data.

NFS SERVER TEST-BED



DISK MIX



successful installation, unlike the others. For example, with DiskShare for Windows NT and NFSware for Windows NT, you had to know that the remote ID "-2" designates a generic account number. This concept may be familiar to Unix users, but it is foreign to most PC users.

Granted, the simplicity of the product represents a trade-off. You don't get the same level of management and tuning features as the other two products offer. Both DiskShare and NFSware, for example, allow you to change a multitude of parameters, such as packet sizes and User Datagram Protocol (UDP) size. Chameleon does not build in this level of flexibility.

SUITABILITY TO TASK	Chameleon32NFS
Scalability	GOOD
Management	GOOD
Ease of use	EXCELLENT

On the other hand, Chameleon does offer a tight level of integration with Windows NT. For example, it is the only product to offer a Chameleon32 network cloud under File Manager, so you can easily locate all NFS servers on your network. If ease of use is a primary consideration, Chameleon is a good choice.

▶ **Chameleon32NFS, Version 4.01.** List price: *$695.* NetManage Inc., *10725 N. De Anza Blvd., Cupertino, CA 95014; 408-973-7171; fax, 408-257-6405; e-mail,* sales@netmanage.com.

Circle 956 on reader service card

NETWORK EDITION

EDITORS' CHOICE

Intergraph Corp.

• DiskShare for Windows NT

Hitting the right balance of numerous features, ease of use, and competitive performance, DiskShare for Windows NT, Version 1.0, earned our Editors' Choice in this roundup. Its user interface is impressive, given the complexity of its features; navigating and configuring the product was a breeze.

SUITABILITY TO TASK	DiskShare for Windows NT
Scalability	GOOD
Management	EXCELLENT
Ease of use	EXCELLENT

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Making NetWare and NT Play Nice Together

Got a Microsoft Windows NT server within your existing NetWare environment? Then you should consider Beame & Whiteside Software's BW-MultiConnect for Windows NT, Version 1.1. You can also look to Microsoft's upcoming NT File and Print Service for NetWare.

Both packages promise to do one thing: offer native NetWare clients (running IPX) full file and print services on Windows NT 3.5 servers. These products make your Windows NT server feel and act like any other NetWare server on your LAN. They offer relief for network managers who are either already running a few Windows NT servers within their NetWare environments, or who may be planning a full migration from NetWare to Windows NT. They eliminate the need for configuration changes to NetWare clients.

These products offer a number of advantages. First, they allow NetWare clients to take advantage of many attractive features within Windows NT, such as multithreading and multiprocessing. They also make IPX the de facto protocol in your environment, thereby minimizing the need to introduce new protocols to your LAN or WAN, which simplifies management. Furthermore, you can share other Windows NT–specific resources, such as printers and disk drives, with all NetWare clients on the network.

BW-MultiConnect for Windows NT has offered this service since the early days of Windows NT 3.1 (see "The NT Door Opens for NetWare Clients," Network Edition, June 28, 1994). At press time, though, Microsoft was still doing beta testing of Windows NT File and Print Service for NetWare and would not commit to a delivery date. BW-MultiConnect is here today and is your only choice if you're looking for a real solution to your NetWare/NT integration challenge.—*ORT*

DiskShare is well integrated with Microsoft Windows NT's File Manager, so it was easy to export directories and add users. Intergraph also offers the most in-depth but easy-to-use documentation set of the three reviewed products. You may be paying for the better implementation, however. At $800, this package is the most expensive here.

Although DiskShare does not offer the same ease of use as Chameleon32NFS does, it is much better than NFSware for Windows NT. And it does offer a number of functional features not found in Chameleon. For example, under DiskShare's excellent integration with File Manager, it prompts users who want to share files or directories to indicate whether they want to share for Windows NT or NFS clients. This feature was not offered in either of the other packages in this roundup.

We tried out some other handy DiskShare features as well, including the statistics-gathering tool that collects NFS data, a feature that allows adjusting the number of threads the application can use, and a tool to export users and groups. Even though there is quite a bit of tuning flexibility, the tuning parameters are easy to use and understand (unlike those in NFSware).

Overall the combination of a rich features, especially the tuning capabilities, and easy functionality makes DiskShare an excellent choice.

▶ **DiskShare for Windows NT, Version 1.0.** List price: *$800.* Intergraph Corp., *One Madison Industrial Park, Huntsville, AL 35894-0014; 800-291-9909, 205-730-2000; fax, 205-730-8300; e-mail,* info@intergraph.com.

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▶ SUMMARY OF FEATURES

NFS Servers

PC MAGAZINE NETWORK EDITION EDITORS' CHOICE

Products listed in alphabetical order ■ = YES □ = NO	Chameleon 32NFS 4.01	DiskShare for Windows NT 1.0	NFSware for Windows NT 1.0
List price	$695	$800	$295
Operates as a Windows NT service	■	■	■
Integrates with Windows NT File Manager	■	■	■
Architecture			
Multithreaded design	■	■	■
True 32-bit Windows NT application	■	■	■
Maximum number of NFS clients	Unlimited	Unlimited	Unlimited
File System Support			
CDFS (CD-ROMs)	■	■	■
FAT (DOS)	■	■	■
HPFS (OS/2)	■	■	■
NTFS (Windows NT)	■	■	■
Printer Sharing			
Windows NT printers	■	■	■
Unix printers	■	□	■
Security			
NTFS security	□	■	■
Encrypted passwords	■	■	■
Technical Support			
Days of free support	90	30	60
Toll-free technical-support number	N/A	800-633-7248	800-722-7770
Technical-support hours (eastern time)	8:00-6:00 M-F	8:00-5:00 M-F	7:00-7:00 M-F

N/A—Not applicable. The product does not have this feature.

Process Software Corp.

• NFSware for Windows NT

Sometimes good things actually do come in small packages (rare as that is with software these days). That was the case in part with NFSware for Windows NT 1.0. We were wary when the Process Software Corp. product arrived on one disk with no written documentation, but our concerns disappeared once we installed it and started testing.

NFSware is highly scalable and tunable and at $295 it is also inexpensive. You do pay, however, for all that func-

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Windows NT users will bite on a wide range of NFS file and print services with BW-Connect NFS Client for Windows NT. It's the first multi-threaded NFS client for Windows. And it's kernel-mode, delivering throughput up to 1,000 Kbps on some platforms. And BW-Connect NFS Server lets you share services with other NFS clients.

For all of your NetWare users, BW-MultiConnect for Windows NT is the catch of the day. With full NetWare server emulation, it provides open access to Windows NT file and print services. And best of all, you won't need to add any extra software on the NetWare client side.

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tionality. Although it is approachable in itself, NFSware is not nearly as easy to use as either Chameleon32NFS or DiskShare for Windows NT.

The challenge of NFSware is configuring the many configurable parameters the product offers. For example, as we were installing the package we kept getting the message "Server cannot start" with no explanation. Finally, we had to resort to calling the technical-support number. The solution involved entering the user name and password in the services control panel. The lack of documentation makes such situations more difficult. Once we became familiar with the contextual help, however, we found that in many cases it was more useful than written manuals.

NFSware was not able to complete our benchmark tests (even after a week and a half of attempts that included several contacts with the technical-support staff). This was mainly attributable to the number of parameters and the difficulty in configuring the product. You can configure virtually every parameter, including the number of threads, TCP segment, and cache size. The number of configurable parameters adds considerably to the product's complexity.

SUITABILITY TO TASK

NFSware for Windows NT

Scalability	EXCELLENT
Management	
Ease of use	

This is a highly scalable, highly tunable product at a good price. But if ease of use is essential, you should consider Chameleon or DiskShare. □

▶ **NFSware for Windows NT, Version 1.0.** List price: *$295.* Process Software Corp., *959 Concord St., Framingham, MA 01701; 508-879-6994; fax, 508-879-0042; e-mail,* info@process.com.

Circle 958 on reader service card

▶ UNIX NETWORKING

Here's a Way to Bring Solaris into the Fold

SunSoft provides TCP/IP client and server software to integrate and regulate PC networks.

By Jeffrey D. Baher

SunSoft enters new territory with the release of SolarNet PC-Admin, Version 1.0. This is SunSoft's first major attempt to deliver a networking solution that integrates DOS, Microsoft Windows, and Solaris platforms. By providing TCP/IP-based connectivity and an array of client features, SolarNet PC-Admin can serve as the glue for uniting these platforms in a NOS-like environment. Network administrators can now install and configure disparate PC clients using Microsoft Windows–based tools on the desktop PC.

We were impressed with SolarNet PC-Admin from all angles. Sure, it's only suitable for environments that run Solaris, but those environments are in for a solid set of services for end users and administrators alike.

SolarNet PC-Admin comprises both client and server software. The client software is a Winsock-compliant TCP/IP stack with a variety of basic utilities such as FTP, SMTP-based e-mail, and telnet. The software is very easy to install and even easier to use. In fact, users of SunSoft's PC-NFS software will find the SolarNet PC-Admin client side remarkably similar.

(Both SolarNet PC-Admin and the PC-NFS line are now marketed under the SolarNet family name, a suite of products dedicated to connecting sundry network operating environments. For more on SunSoft's PC-NFS products, see the sidebar "PC-NFS Goes Pro.")

We loaded the server software on a Sun SPARCstation 2, but you can load it on any SPARC-based system running Solaris 2.3 or higher. Alternatively, you can use any Intel *x*86 system running Solaris 2.4 or higher as a server. We installed the server software effortlessly (as effortlessly as Unix software can be installed, anyway). SolarNet PC-Admin installs a number of services on the server, including POP2 and POP3 e-mail services, and a PC-NFS daemon to allow NFS access for PC clients.

Also installed is support for DHCP (Dynamic Host Configuration Protocol), which reduces administration time by automatically configuring TCP/IP. If an administrator adds new users or changes a default gateway, the TCP/IP configurations of affected users will automatically be defined or updated.

During the installation, we hesitantly followed the product's recommendation to run Network Information Service Plus (NIS+), which is a distributed name service that is included with Solaris. Typically, we run into all kinds of problems when working with NIS+, especially when non-SunSoft products are involved. We were very impressed, however, with the seamless integration between NIS+ and SolarNet PC-Admin. The server software loaded and ran without a hitch.

DHCP, FTP, NFS, AND SO ON

With SolarNet PC-Admin installed, client PCs attach to a SolarNet server during boot-up. If DHCP is enabled on

the PC, the client will dynamically receive all necessary IP address information. As part of the log-on, the client could also receive drive mappings for Unix file systems and access to Unix print queues.

Each client also has access to FTP, NFS, and e-mail services. And if that isn't enough, SolarNet integrates Legato Networker backup software, so that users can back up and archive files to Unix hosts. In essence, what clients get is a NOS environment in which they log on and log off and are granted a wide array of networking services. While the concept certainly isn't new, this is the first time that so many networking services have been so easy to snap together for Solaris and DOS/Windows clients. Don't worry about interoperability, either: SolarNet PC-Admin will peacefully coexist with your Microsoft LAN Manager, Microsoft Windows for Workgroups, or NetWare network environment.

BUILT-IN NET ACCESS: *FTP and telnet utilities are available to every client.*

MANAGER'S TOOLKIT: *The Client and User Manager utilities let you modify user accounts.*

MAIL CALL: *SMTP-based e-mail is also included.*

ALL THIS AND BACKUP, TOO: *Through integrated Legato software, you can back up your PC right from SolarNet PC-Admin.*

You can't have a network without a network administrator, and SolarNet PC-Admin offers a slew of benefits for the administrator as well. For one, the administrator can manage Unix hosts from anywhere on the network. Using the Client Manager or User Manager utilities from the SolarNet PC-Admin client software, administrators can add and delete user accounts or modify access rights. SolarNet PC-Admin also helps ease the headache of managing IP addresses, because it can assign and manage them from a central location.

SolarNet's scripting utility is another great feature. Just like a NetWare login script, this feature allows you to modify users' start-up files so that they connect automatically to specific user groups. Finally, each SolarNet client automatically loads an SNMP agent, so you can manage the whole network using a high-end management platform, such as HP OpenView.

▶ **SolarNet PC-Admin, Version 1.0.** List price: *For 1 server and 1 client, $2,250; additional licenses range from $300 per client for 10 users to $120 per client for 5,000 users.* SunSoft Inc., *2 Elizabeth Dr., Chelmsford, MA 01824; 800-787-7638.*

Circle 951 on reader service card

PC-NFS Goes Pro

SunSoft has sure been busy. In addition to SolarNet PC-Admin, the vendor recently unveiled PC-NFSpro for Microsoft Windows ($375 per user). The Winsock-compliant protocol stack is compatible with both NDIS and ODI network drivers and will work concurrently with IPX, NetBIOS, or NetBEUI networks.

Like several other recently released TCP/IP stacks, PC-NFSpro employs a 32-bit virtual device driver (VxD) architecture for optimal Windows performance. In addition, this also completely eliminates the problem of DOS memory constraints.

PC-NFSpro installs effortlessly and delivers an array of TCP/IP-based end-user applications including FTP, NFS, SMTP-based e-mail, PING, and telnet. The software package also ships with an SNMP agent and support for Dynamic Host Configuration Protocol (DHCP). For dial-up access to the Internet, PC-NFSpro also includes a Point-to-Point Protocol (PPP) 32-bit VxD driver. PC-NFSpro does not, however, include some of the more common Internet applications, such as Gopher or a newsreader. The absence of these features could limit PC-NFSpro's appeal when compared with the wave of TCP/IP Internet bundles currently engulfing the market.

Still, we were impressed with PC-NFSpro. Besides the ease of installation, the package was clearly designed with the end user in mind. The interface is intuitive and easy to learn. These two things are often the weakest points in any TCP/IP product, but not so here.

Our biggest complaint centers on NetWare integration. We were unable to run both PC-NFSpro and NetWare under Windows. All of our NetWare drive mappings were fine initially, but once we launched Windows, we were able only to map Unix hosts.

Today, PC-NFSpro is a competitive product in what is rapidly becoming a commodity market. With more Internet applications and improved NetWare integration, PC-NFSpro could shine.—*JDB*

▶ **PC-NFSpro for Microsoft Windows.** List price: *For 1 user, $375; volume discounts available.* SunSoft Inc., *2 Elizabeth Dr., Chelmsford, MA 01824; 800-786-7638.*

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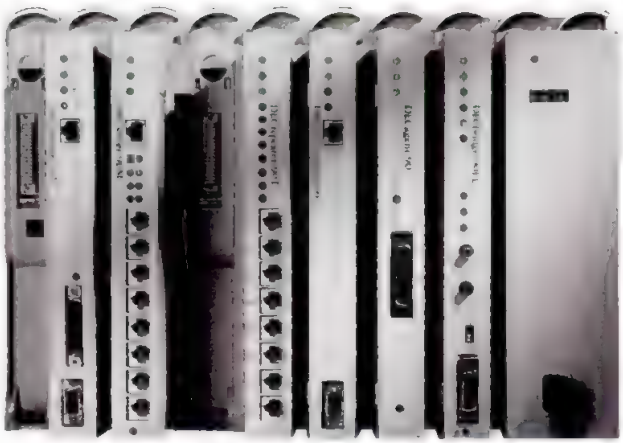

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▶ PRINT SERVER

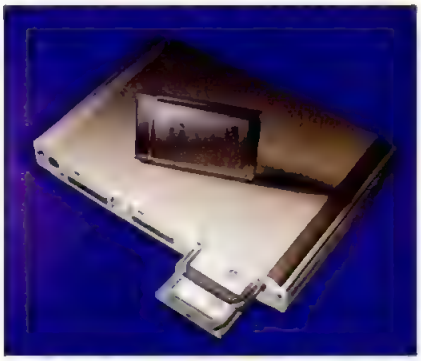
Have It Your Way

BY TONY POMPILI

Microplex Systems' new M204 PCMCIA Print Server is like a chameleon: It's the first multiprotocol print server to support Token-Ring and Ethernet topologies simultaneously. The M204 also gives you the freedom to switch print servers from one network type to another without sacrificing the original investment.

Unlike most standalone print servers, the four-port M204 does not rely on a single, built-in NIC for network connectivity. Instead, it has two Type II PCMCIA slots that can accept Ethernet and Token-Ring adapters to provide a high degree of flexibility. You can customize the M204 to handle one or more of the same network type (Ethernet or Token-Ring) or mix the two in the same box. For example, a PC on a Token-Ring network could print to the same printer as a Macintosh on an Ethernet network.

One fringe benefit: If your company decides to switch from one network type to the other, you can change over your print server without buying a new one by simply popping in a new PCMCIA card.



MIX AND MATCH: You can connect both Ethernet and Token-Ring LANs to the M204.

The M204 was very easy to set up: We just inserted the included Ethernet adapter into one of the PCMCIA slots and connected the box to our network (Microplex's PCMCIA adapters are OEM versions of IBM's Token-Ring and Ethernet adapters).

The M204 firmware can be upgraded through FlashBIOS, so it won't become obsolete (as long as PCMCIA adapters are in style). Finally, like other Microplex print servers, the M204 can handle AppleTalk, IP, and IPX protocols simultaneously.

The downside is cost. Even at street prices, the M204 will run around $600 to $800 with a single PCMCIA adapter—roughly double the price of some other multiprotocol print servers. Still, the cost may be worthwhile for the unprecedented level of flexibility the M204 provides to mixed network environments.

▶ **M204 PCMCIA Print Server.** List price: *$595; Token Ring PCMCIA card, $495; 10BaseT Ethernet PCMCIA card, $295.* Microplex Systems Ltd., *8525 Commerce Ct., Burnaby, British Columbia, Canada V5A 4N3; 800-665- 7798, 604-444-4232; fax, 604-444-4239.*

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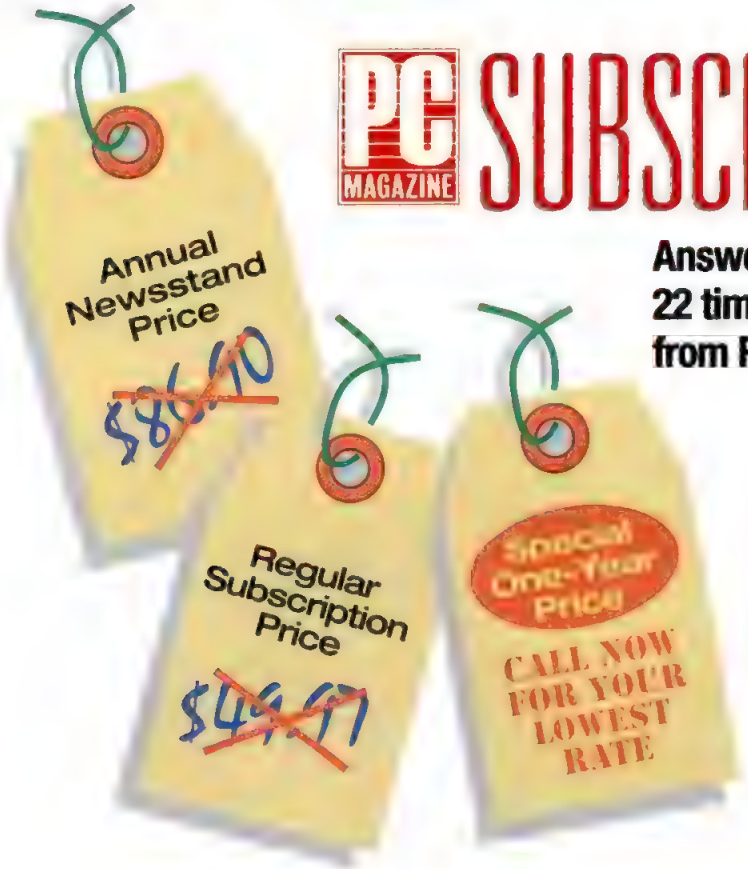

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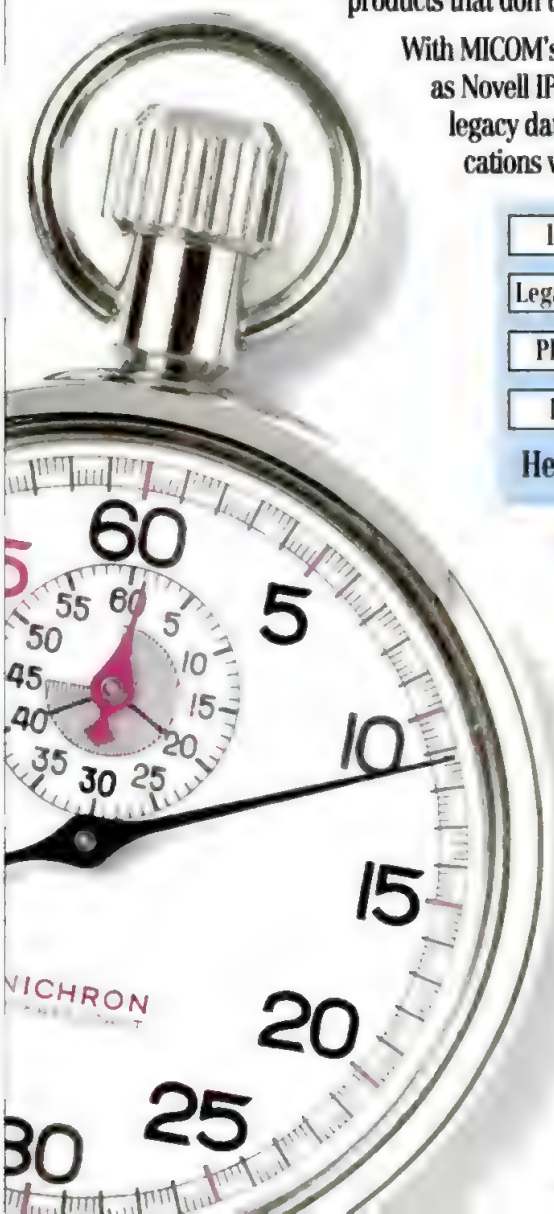

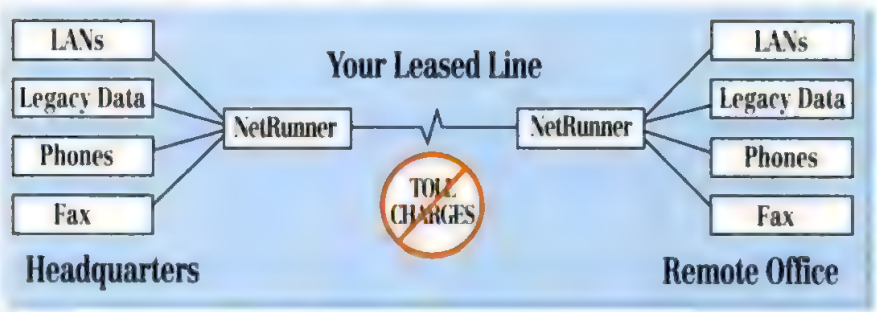

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▶ STACKABLE ROUTER

Wellfleet Stacks the Router Deck

BY STEVE BUEHLER

Need flexibility and expandability in an enterprise router? Check out Wellfleet Communications' new Access Stack Node (ASN). It's the first router to leverage the low price, easy upgradability, and asset protection of a stackable hub to provide a powerful routing solution that can grow with your needs.

The ASN ($4,000) is a PC-size, modular chassis with four slots. Ethernet ($3,000), Token-Ring ($4,000), FDDI ($7,500), and WAN-link modules ($2,300) are available. For a performance boost, you can add an internal Fast Packet cache ($2,500). A typical Ethernet configuration runs about $2,000 per port, which is competitive with similar products from Cisco and 3Com.

WORKS WELL WITH OTHERS: Use Wellfleet's ASN alone or in stacks—for more power.

The ASN differs from its competitors by allowing the addition of one other module: the Stack Packet Exchange (SPEX) module ($750). The SPEX allows up to four SPEX-equipped ASNs to be connected via an external, 160-Mbps backplane (using proprietary cables). When routing needs grow beyond the ASN's capabilities, you can migrate to a central-site router and distribute ASNs out to departmental LANs to begin the growth cycle again and protect your investment.

The ASN routes all major protocols, including AppleTalk, IP, and IPX. Configuration was easy, thanks to Wellfleet's setup utilities. Wellfleet Site Manager provides SNMP management.

As the first stackable router, the ASN makes a very strong showing. Like any first implementation, however, the ASN has some minor flaws. For example, if a unit on the stack fails, the units below it will continue to work even though they can no longer communicate on the backplane. Hot-swappable modules, which could alleviate this problem, are planned for release by the middle of this year.

▶ **Access Stack Node.** List price: *$4,000.* Wellfleet Communications Inc., *8 Federal St., Billerica, MA 01821; 508-436-3680; fax, 508-436-3436.*

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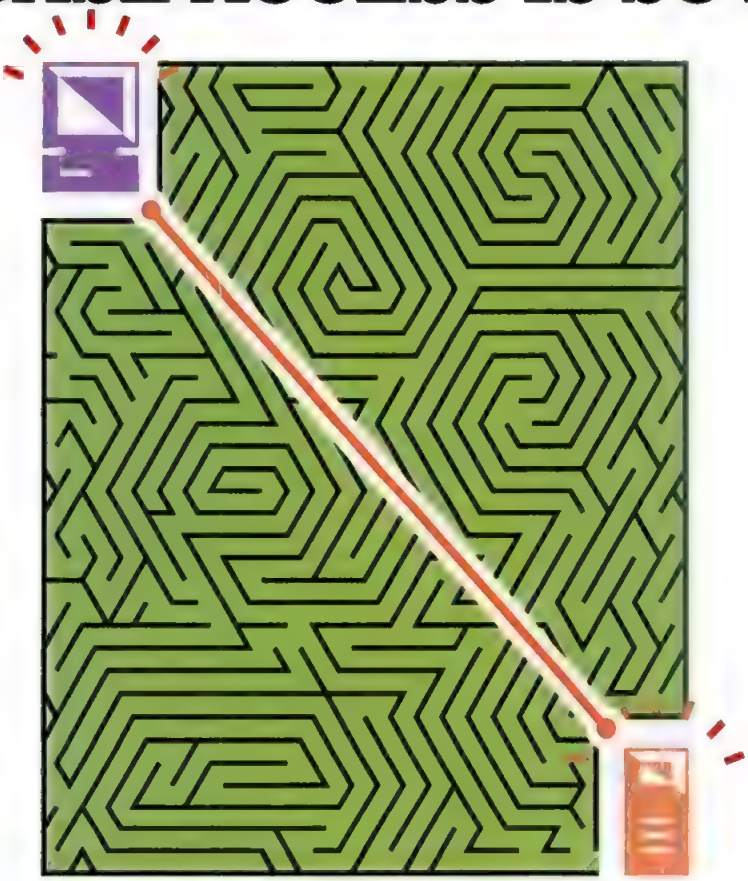

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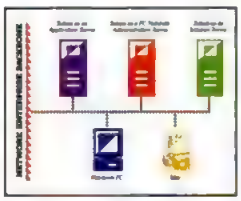

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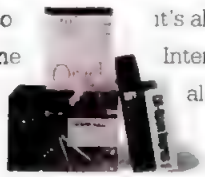

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▶ GROUP DISCUSSION SOFTWARE

Changing Channels

BY TONY POMPILI

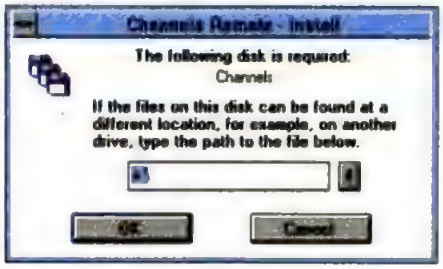
Team Software recently released two major enhancements to its Channels group-discussion package. The first is Channels Remote, which for the first time allows mobile users to take part in Channels discussions. The second is a new version of Channels (Version 1.1), which now works with IPX networks. While the new version adds some decent usability features, we were not terribly impressed with the remote package.

REMOTE POSSIBILITIES

Like Collabra Share and other group-discussion packages, Channels lets users create discussion databases similar to those found on CompuServe and other on-line services. Users can take part in existing conversations or start their own. With the addition of Channels Remote ($69 per user), Channels users can participate in these conversations while at home or on the road by dialing into the LAN.

Don't be fooled by the Channels Remote name: This product does not include any communications software for dialing into the LAN. Instead, Channels Remote relies on an existing cc:Mail or Microsoft Mail system as the communications platform. In other words, if you're not currently using one of these systems, you'll have to buy and install one before you can use Channels Remote.

We had problems with the first software Team sent. During installation, the setup routine asked for a floppy disk that simply did not exist. The documentation, all on-line, did not address this problem.



OOPS: We had to call Team to get this disk.

Team sent us a second package, but even once we got the program installed, we found the process of uploading and downloading discussion messages less than intuitive. You first have to use your e-mail package (cc:Mail in our case) to retrieve any new messages from the Channels server. Next, you have to run Channels Remote to download these messages from the e-mail in-box and put them into the local copy of Channels. If you need to respond to a message you've downloaded, you have to repeat this procedure in reverse. We felt that this whole process could have been greatly simplified.

Channels Remote does include a feature that helps minimize the amount of mail sent back and forth each time you attach to the server. For example, you can configure the Channels server to send you only messages that were created during the last 24 hours.

FACE-LIFT AND MORE

Most of the changes in Channels 1.1 are to the interface, which was already friendly and intuitive in the original version. The main interface, the Channels Manager, now provides more detailed information on discussion threads and topics. For example, you can now see how many messages are in a given discussion thread, much as you can in on-line services such as CompuServe.

Channels messages can now contain sound and graphics objects, so you can add a multimedia touch to your discussions. In order to lessen the impact of this feature on overall network performance, all of the multimedia files are stored on separate file servers.

One other major improvement is that Channels now works with IPX. This means that NetWare users no longer have to load NetBIOS to run Channels, freeing up tons of conventional memory on client PCs.

Finally, Channels 1.1 ships with an expanded licensing scheme that allows an unlimited number of users to read views. This sounds great, but all it means is that anyone can look at the various discussion threads—not at the individual messages. You still need licenses for any user wishing to read, create, or edit individual messages.

For existing Channels sites, Version 1.1's expanded network support and improved interface are helpful but minor upgrades. Channels Remote's multitiered remote-access approach is a bit clumsy.

▶ **Channels Remote.** List price: *$69 per user.* **Channels, Version 1.1.** List price: *For 10-user Starter Pack, $549; for each additional 10 users, $549.* Team Software Inc., *5858 Westheimer Rd., Houston, TX 77057; 800-785-1112, 713-784-4480; fax, 713-784-4498.*

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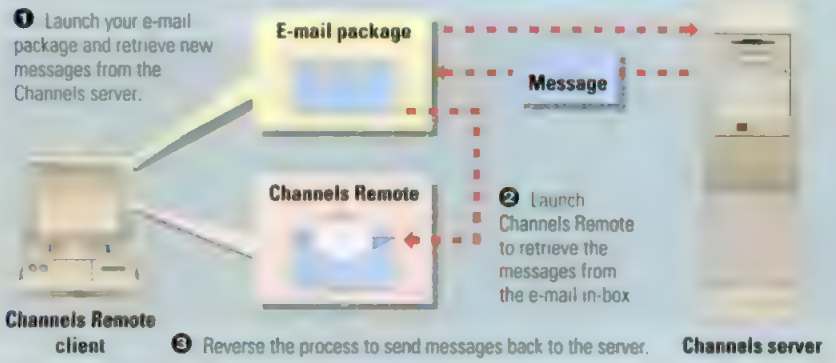
ONE STEP TOO MANY

Unlike Lotus Notes and other group discussion packages, Channels utilizes a cumbersome multistep process for remote use. Channels Remote relies on an existing mail system for communications services.



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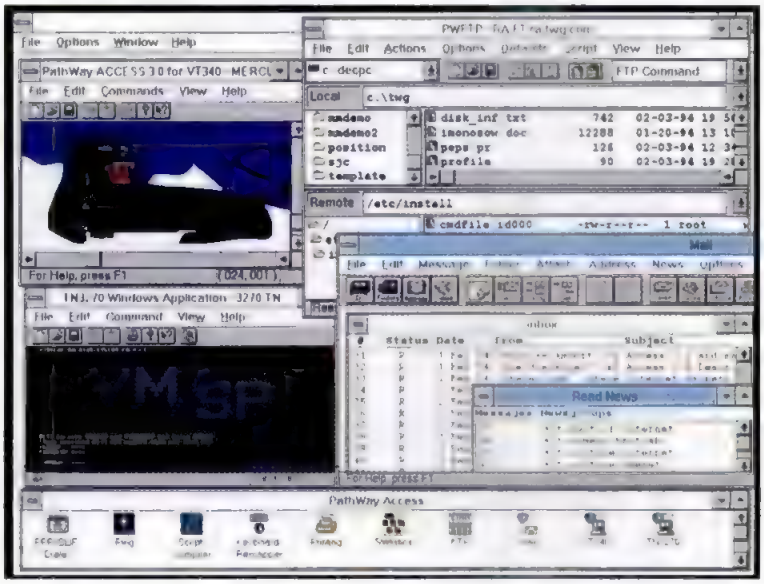

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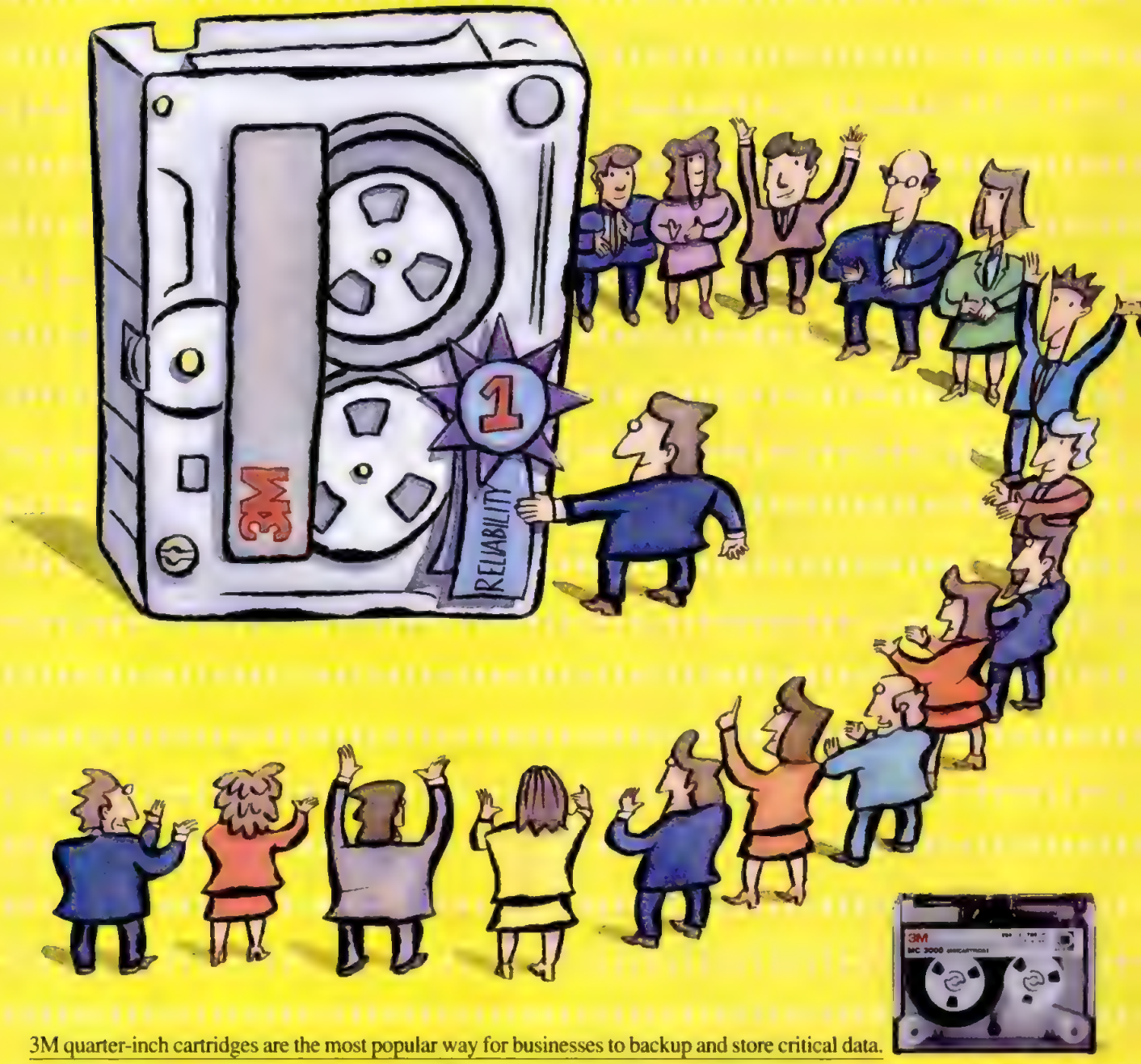

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The Trouble with On-Line Docs

By Diane Danielle

I know, I know: On-line documentation is the greatest thing since sliced bread. But I've decided I prefer baguettes, unsliced. I didn't always feel this way. I mean, the advantages of putting documentation on-line are obvious, right? When it's on-line you can search for whatever you want, any way you want. But there are a couple of not so insignificant flies in the ointment.

First, there's the matter of medium. On-line documentation has to live somewhere and that somewhere is your local hard disk or your server's drive or a CD-ROM. Now the obvious disadvantage of the local disk is that it's local: You move, but the documentation doesn't. A CD-ROM needs a CD-ROM drive. They're still kind of slow; local ones aren't any more shareable than local hard disks (yes, yes, I know you can share local resources with the right software or operating systems, but you know what I mean); and networked ones have a whole 'nother set of problems.

If you do choose the hard disk route, be prepared to give up disk space, and often lots of it. The on-line docs for NetWare 4.1, for example, take up 60MB. Some of you no doubt are yawning and saying, "no big deal," because you've got terabytes of disk space. But I suspect most of you would have to think about taking that much space away from your users and giving it to documentation, especially when you start tallying up all the MB required by all the on-line documentation you need—60MB here, 30MB there, 100MB somewhere else. It adds up.

So, you say, the alternative is to give up a bookshelf, or a bookcase, or two. Okay. I'll buy the argument that disk space is cheaper and more available than floor space. But, have you ever had to *install* a printed manual? You do have to take a manual out of the box and stick it somewhere, but then all you have to do is open it up.

On-line documentation normally requires some kind of installation. The documentation is usually in some proprietary format that can only be read by specialized software that runs under DOS or Windows or OS/2 or Unix. And you know what that means. If something can go wrong, it will. Even when the docs are supposed to be able to run completely off the CD-ROM, sometimes they won't. Believe me, I know. I spent part of my Christmas holidays trying to track down a problem with CD-ROM–based on-line documentation.

As for the wonderful searching capabilities, well, you *have* noticed, haven't you, that everybody's on-line documentation uses a different search engine? Even Novell can't standardize on one (it uses Dynatext for its 4.1 on-line documentation and Folio for its NSEPRO). I can understand the vendors' arguments that different kinds of documentation require different kinds of search engines. But it's still a lot to ask of most users.

Worse, although I usually find that the indexes to most manuals range from awful to merely good, the search engines and the hypertext links in all these different products aren't really much easier to use (although they certainly ought to be). I frequently find myself someplace I didn't expect to be, unable to figure out how to get back to where I was or to where I want to be. And the syntax for doing sophisticated searches (like trying to find out how to install specific versions of three different protocol stacks on the same machine) often requires a degree in symbolic logic.

But perhaps my biggest complaint with on-line documentation is that it's not on paper. Okay, manuals are heavy. Manuals are clumsy. But manuals *can* be carried from one place to another. You can take a manual with you on the subway. Read it while you're standing in line for the ATM. You can carry manuals around in the backseat of your car, so that you can actually take one to a remote site or into a client's office. You can sit down with it there and look up information when the only server on-site is broken which is, after all, the only reason you're reading the manual). You don't need a CD-ROM drive or a mouse.

For one thing, everybody's on-line docs use a different search engine.

What to do? Well, if you've got a functional system somewhere with a fast, duplexing laser printer *and* the freedom to tie them up for a while, print out the documentation and bind it yourself. One day you'll be glad you did.

But vendors should be willing to provide at least one free set of manuals per product to each customer, especially if the product in question is an expensive network operating system. If your vendor doesn't, call the company. Write its president. Complain. Loudly. Some marketing strategies need to be resisted and this is one of them. □

DIANE DANIELLE is an independent networking consultant in Berkeley, California. She can be reached on CompuServe at 72241,2566 or MCI Mail at 383-1159.

Illustration by Peter Alsberg

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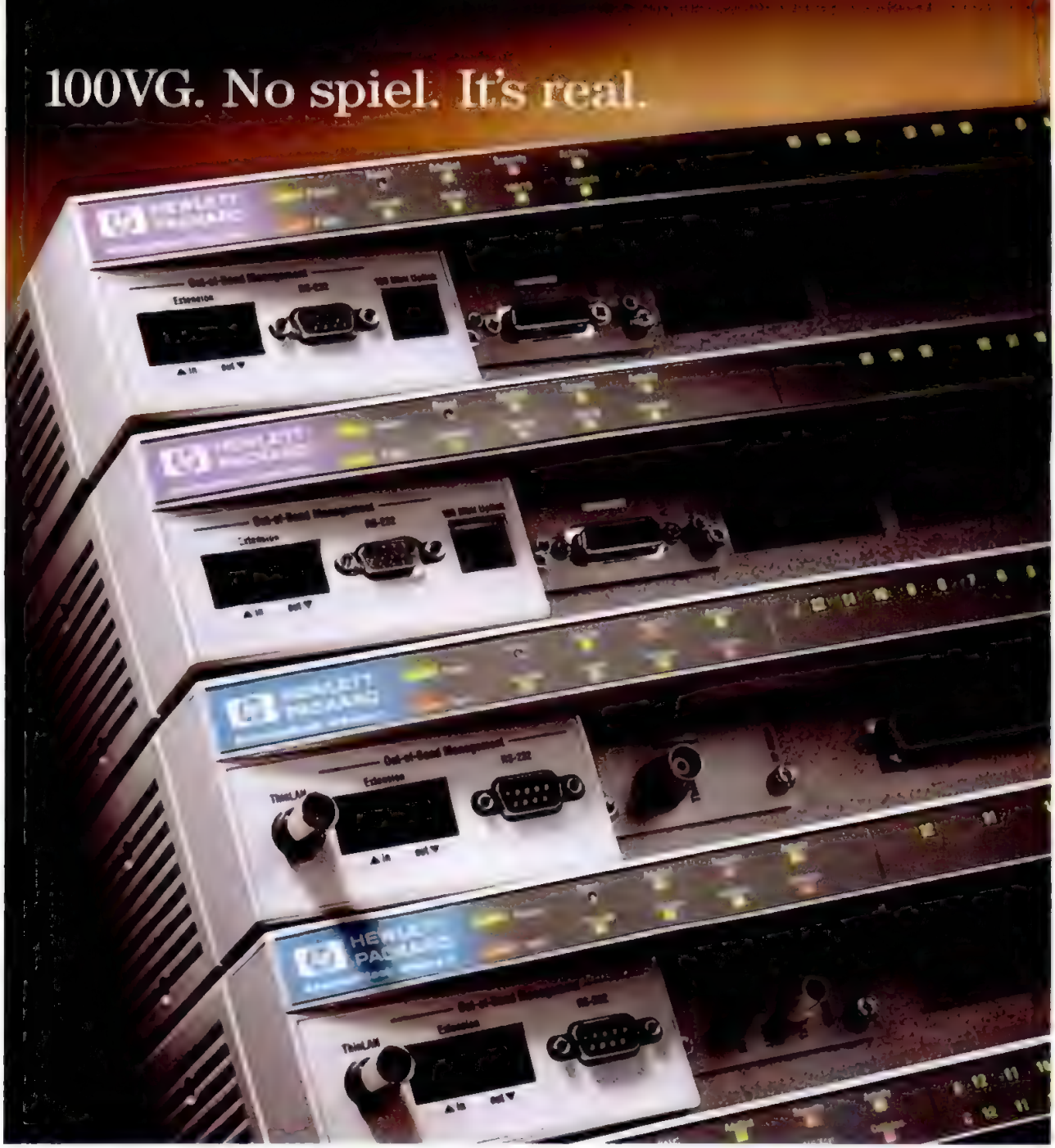

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Directory Services by Any Other Name

When you test as many products as we do, Frank, you're bound to ruffle a few feathers. So I wasn't really surprised to get a call from Willy Donahoo, director of product marketing for the NetWare products division, "asking" about our last NOS roundup. In that article, we said that Microsoft Windows NT Server and OS/2 LAN Server also offer directory services (see "NOS: The Next Generation," Network Edition, December 20, 1994).

We can excuse the folks at Novell for being sensitive about directory services. After all, NetWare Directory Services (NDS) is a key selling point for NetWare 4.*x*. Indeed, Willy's objections help make the point about how difficult the job of comparing—and purchasing—complex products can be.

Novell argues that a global directory service is, at the least, an information service that provides global access to network resources. As the X.500 standard points out, a directory service implementation must be global, distributed, and replicated. These three characteristics are there for good reason, and they help point out why Microsoft's domains miss the mark as a global directory service.

David Greenfield: By industry definitions, Microsoft's domains miss the mark as a global directory service.

Global: A directory service has to span the enterprise. Through the enterprise service a user can easily access any resource. Under domains the only way you could achieve this kind of design without tremendous overhead is by creating a single domain for the entire enterprise.

Distributed: Through directory services you spread information about the network across the enterprise. This means that under NetWare 4.1 users should be authenticated much faster with less network overhead than with NT Server.

Replicated: With replication, the global directory services are remarkably fault-tolerant. Each NDS service contains a portion or partition of the database. If one server fails, the directory service continues to function. With domains, if the primary server should fail, you need to promote a backup manually .

What's more, with replication, anyone can administer a domain, not just the network manager near the console—as is the case with NT Server. There are other differences between domains and directory services, such as the types of object that can be placed in a directory. What ever you call it, Frank, I say that Novell's got the directory services our readers care about.

David, Novell's attitude is "A distributed directory service is what I say it is, and I've got one!" My reply is "So what?" I classify Novell's directory-service architecture as dynamic. Lots of busy servers and comm lines. It stores user information like smokestack industries stored raw materials. In my terms, Microsoft's architecture is referential. A server gets what user information it needs when it needs it. This is much more like streamlined "just in time" industries.

You might think or hope that every Jack and Jane user is going to go out and surf your corporate web to access resources everywhere, but you're dreaming. Most people load one to three local apps and stay in them all day. Why move all that user ID data around when you don't need it? This is the same mentality behind all that replication and overhead in Lotus Notes.

Frank Derfler: Who cares? Better to move a little of the right data sometimes, rather than tons of data all the time.

In the Microsoft model, when you try to use a resource on a distant server, it checks out your rights with your domain server across a secure link. If you're okay, you're in. This system has one log-on for *all* services. Microsoft also built the smarts into NT Server that give it the capability to log you on automatically to NetWare and VINES servers too.

There are some other practical advantages to the Microsoft domain architecture. For example, a large organization will find it smart to keep the information on all users and their rights in one domain server. The folks in corporate human relations (HR) get the task of adding and deleting names from the domain server. So, if someone is "escorted from the building" at 3 P.M., HR can have the name deleted from the domain by 3:01, and that's it. In some other "dynamic" naming models, the process could take a lot longer—thereby giving a disgruntled ex-employee an opportunity for mischief.

Note that in this scenario the HR people don't control data resources. They don't input who or what group can access Q:\database\stuff. The Microsoft model allows the appropriate people to assign resources, but HR can add or delete people in the domain.

So, David, as far as naming goes, it comes down to "tell me now or tell me later." Frankly, I prefer moving a few pieces of the right information at the right time rather than moving tons of unneeded information all the time.□

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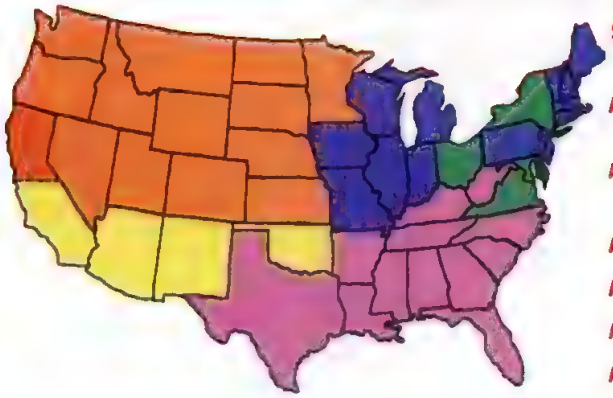

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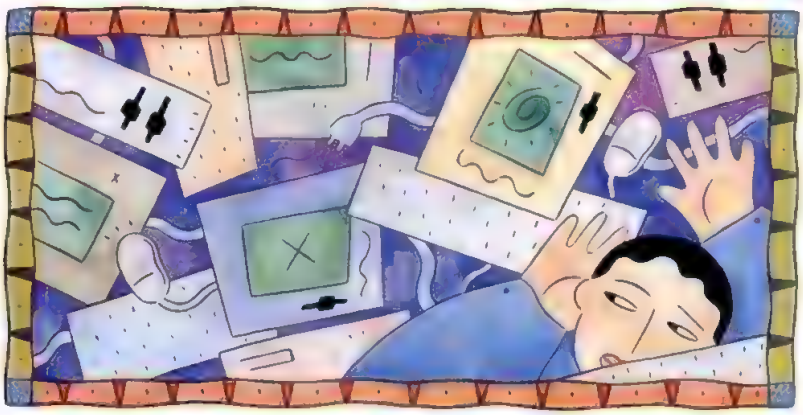

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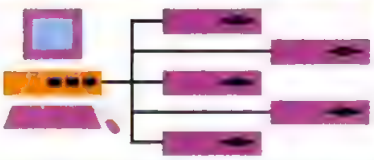

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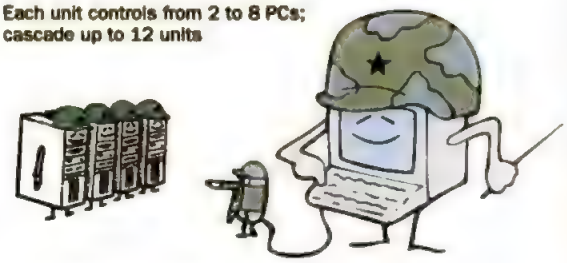

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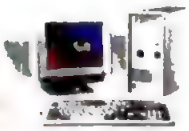

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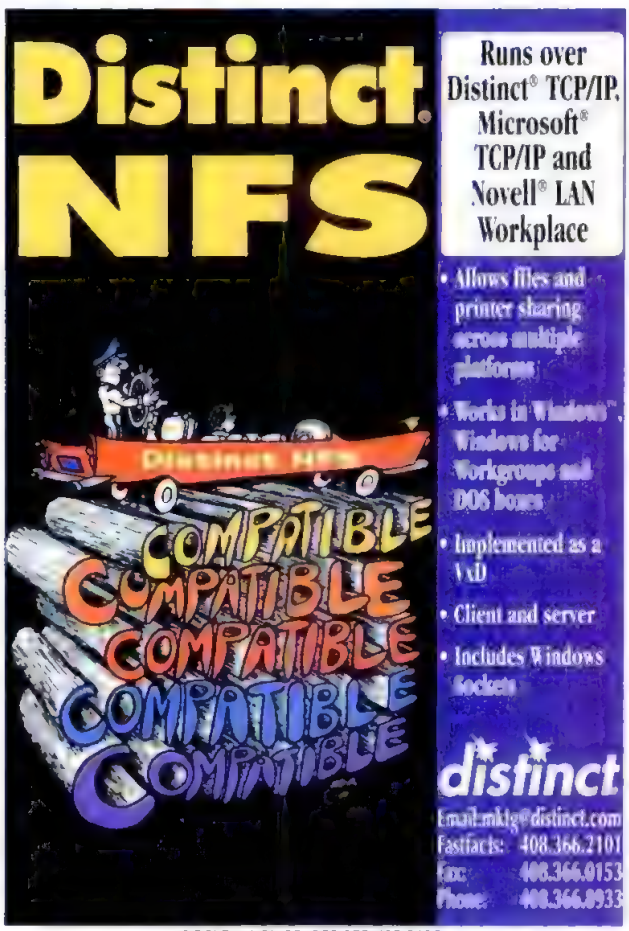

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Turn a piggish program into a smooth multitasker with just a few lines of code. Contributing editor Jeff Prosise discusses the use of secondary message loops in this issue's Power Programming.

User-to-User

BY NEIL J. RUBENKING

Speed Up Installations Under Windows

Here's a trick I've used to speed up installations of Windows apps. If you have a one-pass, fast-copy utility, copy the first install disk into a directory called DISK1 on your hard drive. Then copy disk 2 into a subdirectory of DISK1 called DISK2. Copy disk 3 into a subdirectory of DISK1 called DISK3, and so on. When you're done copying, type install in the DISK1 directory and the program will install from your hard disk to your hard disk in about 5 seconds if you have a fast system. Whatever you have, the process will go much faster than watching your floppy read and write. . . read and write. . .read and write. . . .

J. Glaser
via the Internet

▶PC MAGAZINE: You do have a one-pass, fast-copy utility, it's DOS's own XCOPY command. XCOPY is decidedly faster than the copying subroutine in most install programs. If you can XCOPY all of a program's floppy disks to your hard disk and still leave enough room to install the program, this will almost always speed up the installation process.

In most cases, you don't actually need to create the directory structure described above, with a separate directory for every floppy disk. Simply XCOPY all of the disks into the same directory on your hard disk and run the INSTALL or SETUP program from that directory; usually everything will run smoothly. Then simply delete the directory when the installation is complete.

Tips for Using INCTRL

▶PC MAGAZINE: Many Windows programs behave like uninvited house guests—they install themselves all over your system, drape dirty laundry over the shower rod, and take your favorite chair. Utilities that help you to uninstall Windows programs are more and more popular. My own INCTRL utility (available on ZiffNet's TIPS forum, Library 2, as INCTRL.ZIP) is a simple way to prepare for the possible need to uninstall a program. INCTRL takes over running the install program and watches its every action. After the installation, INCTRL presents you with a report of files that have been created, deleted, or changed, and gives you the specifics of any changes made to WIN.INI and SYSTEM.INI.

I get a lot of e-mail about INCTRL, mostly in the form of requests for added features. It's likely that I'll eventually upgrade the program, but in the meantime there are workarounds for some of the common questions. The current version is 1.03, so you should start by making sure you have the latest.

More and more install programs these days take optional command-line parameters that INCTRL isn't equipped to handle. Here's how to get around that problem. Run INCTRL, but instead of supplying it with the actual install program's name, give it the name of an innocuous Windows program like NOTEPAD. INCTRL will do its preparatory work and then load NOTEPAD. At that point, run the install program in the usual manner, by choosing Run from ProgMan's File menu, and include the necessary command-line parameters. When the installation is complete, close NOTEPAD. INCTRL will complete its report just as if you had run the install program directly.

INCTRL does its best to execute the selected install program in exactly the same fashion as Program Manager does. However, if for any reason a particular install program seems incompatible with INCTRL, you can use this same workaround.

In order to detect changes to the file system, INCTRL "memorizes" the current information for all files on your system. It uses an internal data structure that has a limit of 16,380 items for this purpose. If your system has more than

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16,380 files and directories, you'll need to limit the drives scanned by INCTRL. Look for INCTRL.INI in your Windows directory; if it's not there, create it. Find or create a section titled "[Excluded drives]". For each drive you want to exclude, add a line in that section like "D=1". You may want to insert a line for each drive on your system and then put a semicolon in front of the lines corresponding to the drives you don't want to exclude, for example:

These workarounds should make it possible to use INCTRL for the vast majority of your installations.

```
[Excluded drives]
;C=1
D=1
E=1
```

In this case, drives D: and E: will be excluded; only drive C: will be processed.

There are some things that INCTRL just won't do. It doesn't track installation to network servers, for one. And if the install program has to restart Windows or reboot the system midway during its execution, INCTRL won't be able to track the entire installation process. But with the workarounds listed above, you should be able to use INCTRL for the vast majority of your installations.

An Even Better DOS Prompt for Windows

One of the things I liked about the DOS boxes in OS/2 was the prompt at the top of the screen that told you what type of window you were using. With some help from ANSI.SYS, and some uncommon escape codes, I was able to emulate this prompt for Windows.

The prompt I use shows the time, the current directory, and a blue status bar across the top of the screen with some help text. In my case, the text tells me I'm in Windows, that using Ctrl-Esc will display the task list, and that typing HELP will get help. To use this prompt within each Windows DOS box, you need to set the WINPMT environment variable in your AUTOEXEC.BAT before running Windows.

```
SET WINPMT=Time... $t$h$h
$h $p$_$g$e[s$e[H$e[1;44m
$e[K WINDOWS{tab}{tab}
CTRL+ESC $Q Task List{tab}
{tab}{tab}enter HELP $Q help
$e[40m$e[u
```

The prompt takes advantage of some features of ANSI.SYS I discovered while reading through the help file that now comes with MS-DOS. First, it prints the word "Time" and three periods; `$t` displays the actual time. The three `$h` characters that follow are backspaces that remove the hundredths of a second from the time. After a space, `$p` displays the current directory. The `$_` starts a new line, and `$g` displays the familiar > prompt.

Now we get more complicated. `$e[s` saves the current cursor position. `$e[H` moves the cursor to the home position, which is the upper left corner of the screen. `$e[1;44m` sets the current background color to blue, and bolds the current text being displayed. `$e[K` erases the current line. Next comes the string you want to display. Note that the `$Q` creates the = in the text. Also, you must use tabs for empty space since the string is limited to 128 characters; use Windows Notepad to embed the tabs in the string, since most editors replace tabs with spaces. Finally, `$e[40m$e[u` changes the colors back and restores the cursor position.

Change the colors, change the prompt, and you'll never forget what session you're really running.

Rutherford Le Blang
Troy, New York

►**PC MAGAZINE:** This is an excellent idea, and I've taken it a little further in WPROMPT.BAT (Figure 1). This batch file sets the WINPMT variable to display still more useful information across the top of the DOS box. Besides the reminders included in Mr. Le Blang's prompt, WPROMPT.BAT adds Alt-Tab to switch windows, Alt-Enter to toggle between full-screen and windowed, and EXIT to exit the DOS box. WPROMPT.BAT builds the prompt from the smallest units possible, so you can easily see the purpose of each element of the prompt string. Insert the line `CALL WINPMT.BAT` in your AUTOEXEC.BAT file and you'll never be lost in a Windows DOS box.

You can download this batch file from PC MagNet as WPROMP.BAT. □

```
@ECHO OFF
REM Print directory, greater-than sign
SET WINPMT=$p$g
REM == Memorize cursor position
SET WINPMT=%WINPMT%$e[s
REM == Move to top left of screen
SET WINPMT=%WINPMT%$e[H
REM == Set blue background
SET WINPMT=%WINPMT%$e[1;44m
REM == Clear to end of line
SET WINPMT=%WINPMT%$e[K

REM == Print "ALT+ENTER"
SET WINPMT=%WINPMT%ALT+ENTER
REM == Print equal sign
SET WINPMT=%WINPMT%$Q
REM == Print "Win/Full"
SET WINPMT=%WINPMT%Win/Full

REM == Print a tab, then "CTRL+ESC"
SET WINPMT=%WINPMT%      CTRL+ESC
REM == Print equal sign
SET WINPMT=%WINPMT%$Q
REM == Print "Task List"
SET WINPMT=%WINPMT%Task List

REM == Print a tab, then "ALT+TAB"
SET WINPMT=%WINPMT%      ALT+TAB
REM == Print equal sign
SET WINPMT=%WINPMT%$Q
REM == Print "Switch"
SET WINPMT=%WINPMT%Switch

REM == Print a tab, then "(enter EXIT, HELP)"
SET WINPMT=%WINPMT%      (enter EXIT, HELP)

REM == Set black background
SET WINPMT=%WINPMT%$e[40m
REM == Restore saved cursor position
SET WINPMT=%WINPMT%$e[u
```

***Figure 1:* CALL this batch file from your AUTOEXEC.BAT, and you'll have a help line at the top of every Windows DOS box.**

Tutor

BY JEFF PROSISE

Color Optimization And Dithering

In the last Tutor column, we looked at Microsoft Windows' palette manager, which allows application programs running on 256-color video adapters to display the colors of their choosing without robbing other applications of their color choices. The palette manager is an important component of the Windows Graphics Device Interface (GDI). Without it, 256-color systems would be poor platforms for running Windows, as 16-color systems are today.

This issue, we'll discuss two techniques that applications relying on the palette manager use to optimize their color output. The first is *color quantization*—a procedure for picking the best 256 (or fewer) colors to represent images containing thousands, perhaps millions, of different colors. Specifically, we'll discuss a technique known as *median-cut* color quantization, developed in 1982 by the New York Institute of Technology's Paul Heckbert, which is widely used today in image-processing programs and other computer graphics applications. The second is *dithering*—arranging palette colors in patterns of dots to produce the illusion of more colors. We'll look at a particular type of dithering called *Floyd-Steinberg diffusion dithering*, which is relatively simple to apply and yields some fantastic results. Used together, median-cut color quantization and diffusion dithering can make a PC that displays 256 colors look almost as good as one that displays millions. Here's an inside look at how each of them works.

MEDIAN-CUT COLOR QUANTIZATION

Suppose you're a Windows application running on a 256-color system and the user loads a 24-bit bitmap image containing thousands of different colors. (The term *24-bit* means that the color of each pixel in the image is represented by a 24-bit value—8 bits each for red, green, and blue.) The image contains many subtle shades of blue, yellow, and green, but only a little red. Before you program Windows' system palette with 256 colors, you must decide which 256 colors will produce the best picture of the bitmap. How do you pick the "best" 256 colors?

One approach is to program the palette with a rainbow of colors representing black, white, and an even distribution of colors in between. With 256 colors at your disposal, you could create a palette containing 16 different shades of 16 different colors. This is the fastest approach (requiring the least amount of code and the least processing time), and one frequently used by Windows application programs. The chief advantage to this method—other than processing speed—is that it guarantees there will be a palette color reasonably close to every color in the bitmap. The disadvantage is that the image stands to lose some of its subtle variations in color. A hundred different shades of blue, for example, might be converted to only two or three shades. A sky that fades smoothly from light to medium blue in the original image might take on a banded appearance when it is displayed on the screen, stepping from light blue to medium-light blue and finally to medium blue.

Another often-used approach is to count the number of colors in the bitmap and the number of times that each color appears, and program the palette with the 256 colors that are used the most. This will restore some of the subtle variations in color, but it could eliminate infrequently used colors altogether. The graduated blue sky might be restored, but if a small red

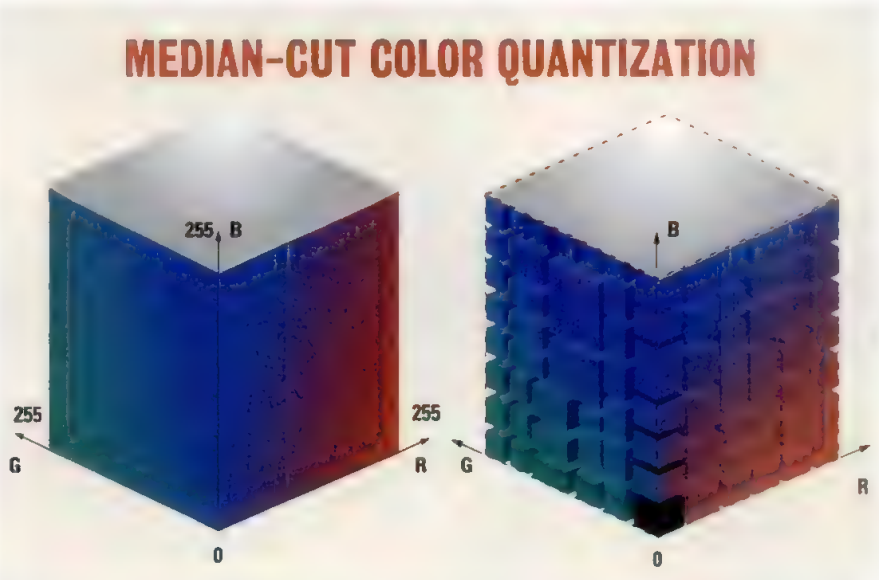

Figure 1: **The median-cut method divvies up 3-D color space by dividing a box encompassing all the colors in the image at the median point along its longest axis, dividing the two resulting boxes in the same manner, and continually repeating this process until there are as many boxes as there are desired palette colors. Palette colors are then picked at the center of the resulting boxes, or by averaging all the colors inside each box. At left is the original color cube with R, G, and B axes; at right is the cube subdivided into 256 partitions, each containing approximately the same number of colors.**

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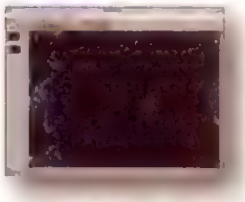

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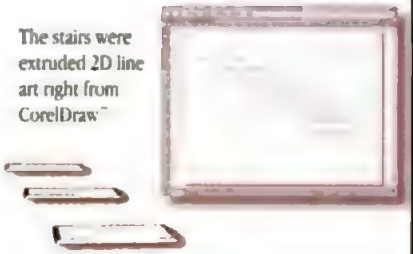

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stop sign contained the only red pixels in the image, the palette might contain no reds, and the stop sign would be color-shifted to yellow or green. Worse, if the sky contained so many shades of blue that no shade appeared more than a few times, the blues might get "voted out" of the palette even though the picture's overall blue content is very high.

Median-cut color quantization combines the best qualities of both of the previous approaches to produce a palette that, to the extent possible, duplicates the subtle tones in the bitmap without completely eliminating any colors.

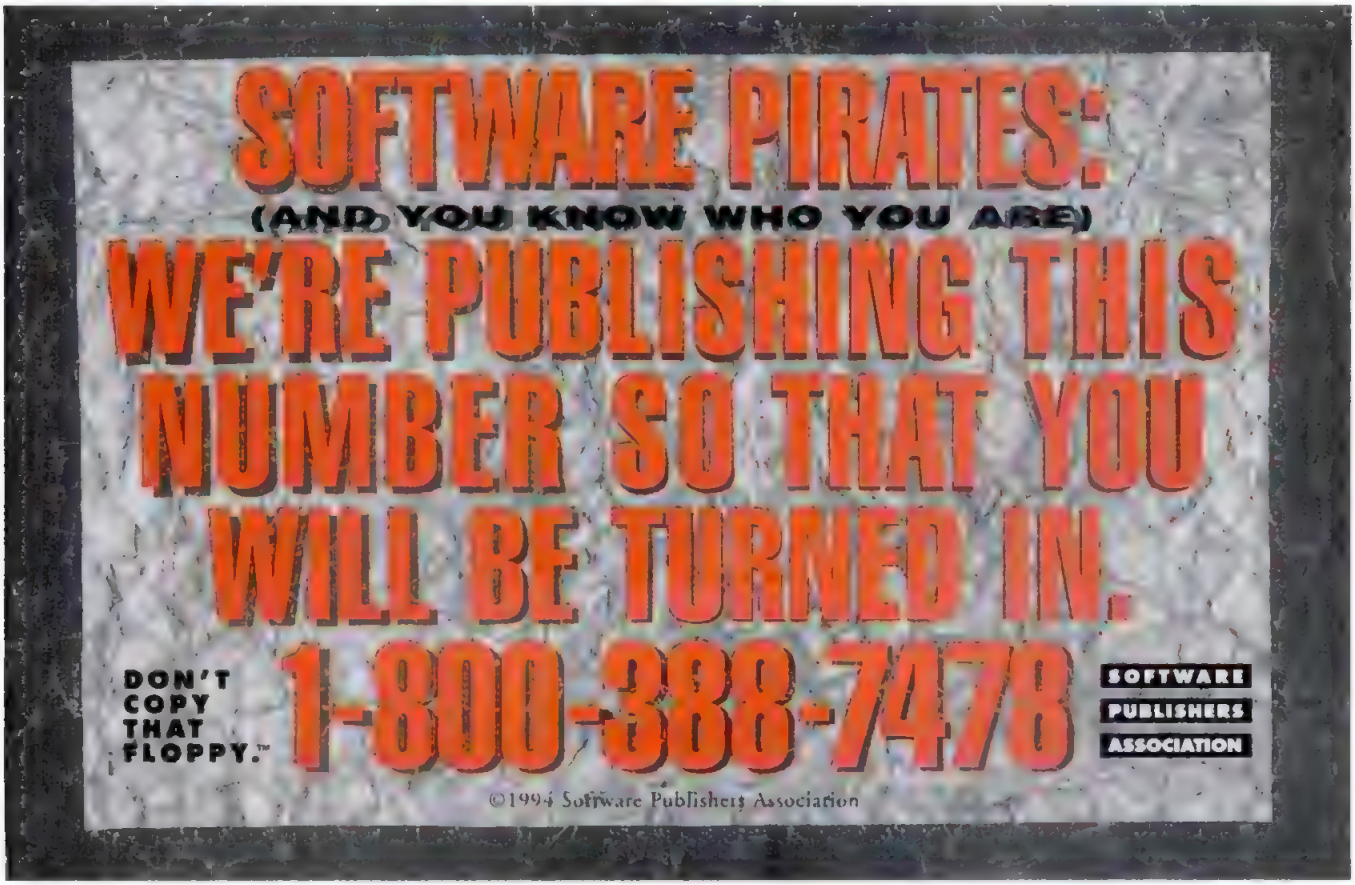
In order to visualize the technique, think of RGB color space as a three-dimensional cube, as shown in the left half of Figure 1. The cube's axes correspond to the three primary colors: red, green, and blue. Like a point in a three-dimensional graph, any RGB color can be plotted as a dot inside the cube by measuring outward from the origin along the R, G, and B axes the amount specified by the color's red, green, and blue color values. Since each color component is represented with an 8-bit value, each axis of the color cube runs from 0 to 255. If you plotted the color of every pixel in our hypothetical image, you'd find that some regions of the color cube are densely populated with dots, while other regions have few dots or none at all.

A finely tuned palette is a good start, but for really high-quality output, you need dithering too.

The idea behind median-cut color quantization is to pick the palette colors so that regions of the cube with more dots get proportionally more palette colors, while regions with sparse dot populations get proportionally fewer. This biases the palette so that colors with many subtle shades get correspondingly more palette entries to represent them.

Picking the palette colors this way is really simpler than it sounds. The brilliant mechanism behind the median-cut method is a simple recursive procedure (one that repeats itself) for divvying up the palette colors to reflect the distribution of the image colors.

The algorithm goes like this: First, an imaginary box is drawn around the dots representing all of the image colors. The box may or may not be as large as the color cube; if no color has a red component less than R=8, for example, then one end of the box falls at exactly R=8. The algorithm then picks the box's longest side and divides it in half at the median point. The median point is not necessarily the midpoint. If there are 1 million pixels in the image and the box is being divided along the R axis, the computer sorts the 1 million R values, and the median point is the R value in the 500,000th slot. If there are far more points with low R values than high R values, the median might fall at R=60. The box is now divided into two smaller boxes, each containing roughly an equal constituency of colors.



The same procedure is now applied to the two smaller boxes. If necessary, each box is "shrunk" so that it just encompasses the pixels inside it. Then it is divided at the median point of its longest axis. Subdividing the blocks in this manner yields four boxes of unequal size but containing roughly equal numbers of colors. This process is repeated until the original box is subdivided into a number of boxes that equals the desired number of palette colors. The right half of Figure 1 shows what the resulting partitions might look like. Once the subdivisions are made, picking palette colors is as simple as computing the RGB value that lies at the center of each box, or computing the centroid of each box by averaging the colors inside it.

The result is a color palette that does a pretty good job of representing the actual colors in the image. The many shades of blue in the original image result in a correspondingly high concentration of palette colors with small variations in blue. And the red in the image won't go away completely because at least one of the palette colors will have a significant amount of red in it. Graphics programs such as Adobe Photoshop frequently refer to this as an *adaptive* palette. Pick the adaptive palette option in an image-processing program, and there's a very good chance that you'll get a palette optimized with the median-cut method.

FLOYD-STEINBERG DIFFSION DITHERING A finely tuned palette is a step in the right direction, but even it can help only so much. A 256-color system is still limited to displaying 256 colors, no matter how clever the software running on it is. For really high-quality output, the image must be dithered.

Dithering arranges pixels in such a way that their colors blend together and make the image appear to contain more than just the palette colors. Imagine that your palette contains only two colors—blue and yellow—and you want to display green. By packing alternating dots of blue and yellow close together, you could create a block of color that resembles green. That's dithering in its simplest form.

A good dithering algorithm is important because dithering a true-color image is rarely as simple as picking out large swatches of color and replacing them with patterns of primary colors. The algorithm must be able to handle images of all types, even if there are no two neighboring pixels alike. The Floyd-Steinberg diffusion dithering algorithm is among the best. A program that uses the Floyd-Steinberg approach examines each pixel in the image, changes its color to the nearest palette color, and computes a color error by subtracting the RGB values of the palette color from the RGB values of the pixel's originally intended color. Then it distributes, or diffuses, the error among neighboring pixels. When applied one-by-one to every pixel, the result is a finely dithered image that resembles the original very closely but uses only colors found in the palette.

Figure 2 shows how color error is calculated for a single pixel and distributed among its neighbors. Suppose the pixel's actual color is R=100, G=120, and B=140, and the nearest palette color is R=128, G=128, and B=128. The color error is therefore R=-28, G=-8, and B=12. That error is distributed between the pixel to the right of the target pixel and the three below it using the Floyd-Steinberg filter, which is also depicted in Figure 2. The pixel immediately to the right gets 7/16 of the error. Its R value is decreased by 7/16 of 28, which is about 12; its G value is decreased by 7/16 of 8, or 3; and its B value is increased by 7/16 of 18, or 8. If that pixel's original color value was R=160, G=168, B=140, then its new value is R=148, G=165, and B=148.

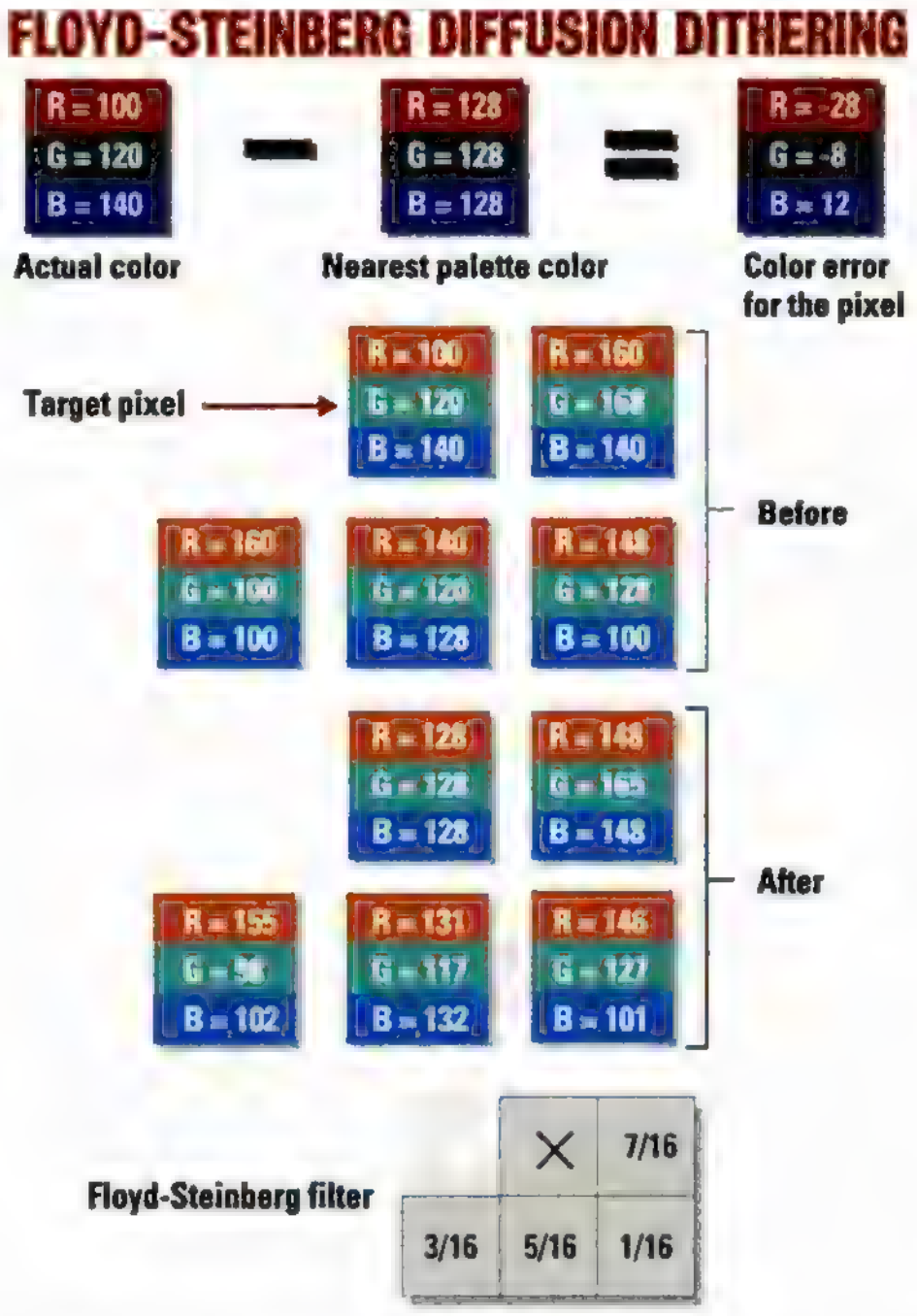


Figure 2: **Diffusion dithering works by setting each pixel in an image to the nearest palette color and then distributing the error—the difference between the pixel's intended color and the palette color—among neighboring pixels. In Floyd-Steinberg diffusion dithering, the Floyd-Steinberg filter dictates how the color error is distributed. The X represents the target pixel.**

The pixel to the right of and below the target pixel is modified in the same way, but it gets only 1/16th of the total color error. The pixel immediately below the target pixel and the one to the left and below get 5/16 and 3/16 of the error, respectively. The sum of 1/16, 3/16, 5/16, and 7/16 is 1, so all the color error associated with the target pixel is distributed, but overall no additional color error is introduced in the image.

This process is applied once to every pixel in the image. Every pixel gets mapped to a palette color, and the shape of the filter combined with the order in which pixels are processed ensures that no error is distributed to a pixel after it has been mapped to a palette color. A dithering program that uses the filter shown in Figure 2 starts with the pixel in the upper-left corner and proceeds horizontally from left to right until it reaches the end of the row. Then it starts again with the leftmost pixel in the next row and continues until every pixel in every row is processed. Other forms of diffusion dithering may be performed by modi-

The Effects of Palette Optimization and Dithering

True-color images can be simulated quite reasonably on 256-color systems by combining median-cut color quantization and diffusion dithering. The image at the top is the original image displayed in 24-bit true color. The grid beneath it shows the same image displayed in 256 colors with and without palette optimization and dithering. The image in the upper-left quadrant uses an unoptimized palette (a rainbow palette with an even distribution of colors) and is not dithered. The image at upper right is dithered, but uses the same unoptimized palette. The image at lower left uses a median-cut palette but is not dithered. The image at lower right uses both an optimized palette and a diffusion dither.

Original Image

Undithered

Diffusion Dithered

Unoptimized Pallette

Median-Cut Pallette

fying the filter values, processing the pixels in a different order, or both.

THE RESULTS The sidebar "The Effects of Palette Optimization and Dithering" shows the effects of median-cut palette optimization and diffusion dithering, alone and in combination. The image at the top, which comes from the tutorials included with Adobe Photoshop, is the original true-color image containing thousands of different colors. The grid below it shows four versions of the same image in 256 colors. It is barely distinguishable from the original, and dramatically illustrates how palette optimization and dithering can work together to make the most of 256-color video hardware.

In general, the smaller the palette, the more important optimization and dithering become. Had there been fewer colors to choose from in this example—had the palette been limited to just 16 colors, for example—the difference between the lower-right image and the others would have been much more pronounced. You can avoid all these color shenanigans by purchasing a true-color video adapter. But in cases where that's not feasible, a few good algorithms can go a long way toward making up the difference. □

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Toolkits

BY JONATHAN WALDMAN

Multimedia Power

A developer can spend a great deal of time and money acquiring an arsenal of tools to develop a full-fledged multimedia application. Lenel Systems offers a single $695 solution called MediaDeveloper 2.1, a comprehensive Windows 3.1–compatible development and productivity tool that makes it easy to manage a plethora of multimedia object types. This ambitious product attempts to suit the needs of both end users and programmers. End users will enjoy MediaDeveloper's icon-driven interface. Programmers will want to use MediaDeveloper as an OLE 2.0 automation server, a VBX, a C++ class, or as a library of DLLs. By sporting so many access options, MediaDeveloper is useful to nearly everyone.

The most notable advantage of MediaDeveloper is that unlike the Windows 3.1 MCI (media control interface) specification, it provides a single API, which addresses modern multimedia needs in a consistent way. For example, to create a thumbnail representation of a visual multimedia object, you use the CreateDIBThumbnail method—a method not offered by the standard MCI. Another MediaDeveloper improvement upon MCI is that the Play method is used for *all* object types, including graphics, audio files, animations, and analog and digital video.

Numerous formats are supported, but the core package supports only the most popular multimedia object types. To control a laserdisk player, display MPEG video, or use a Twain-compliant scanner, you must purchase add-ons from Lenel. You are not limited to formats supported by MediaDeveloper. An MCISendString method lets you directly access the MCI layer.

Another welcome feature of MediaDeveloper is its compliance with standard naming conventions. For example, the OLE property UseSegmentMarks, which allows an object to be played based on the StartSegment and EndSegment properties, is called UseSegmentMarks for the VBX control and C++–class interfaces, and lnlUseSegmentMarks for the DLL.

MediaDeveloper distinguishes itself from other multimedia programming toolkits in its full implementation as an OLE 2.0 automation server. Most development tools are clients, but not servers. This lets a client application (such as Visual Basic) drive a server application (such as MediaDeveloper) using its exposed objects. A full automation server, unlike a "mini" automation server, can also run as a standalone application. Thus, MediaDeveloper can be used by end-users as a powerful multimedia viewer, and can be used by programmers as a programmable object. Finally, the automation features make MediaDeveloper available to development tools that support OCX controls, such as Microsoft Access 2.0.

Lenel's design philosophy is that developers should have full control over the presentation of a multimedia object. This is provided through the Multimedia Object Window and its properties. Version 2.1 includes new properties such as TopBorderColor, BottomBorderColor, LeftBorderColor, RightBorderColor, BackColor, and BorderWidth. These attributes, along with those available from prior versions of the software, control the precise appearance of the Multimedia Object Window.

Also new with Version 2.1 is the ContinuousPlay property, a feature that lets an object loop continuously or a set number of times. In prior releases, such manipulation was the responsibility of the programmer.

MediaDeveloper shows little weakness and imposes only a few limitations. For example, while many graphic formats can be read, only certain ones can be written. Also, the documentation is weak in a few places. For example, the program notes explain that multimedia object data can be stored to and retrieved from a database, but it is sketchy on implementation details. Those wishing to use the product in this way may find themselves accessing the free 60-day technical support.

MediaDeveloper's consistent interface, royalty-free distribution license, and estimable abilities make it an excellent choice for professional multimedia software development.

▶ **MediaDeveloper, Version 2.1.** List price: *$695.* Requires: *386-based PC or better, 4MB RAM, 80MB hard disk space, DOS 3.1 or later, Microsoft Windows 3.1 or Windows NT.* Lenel Systems International, *290 Woodcliff Office Park, Fairport, NY 14450-4212; 800-225-3635, 716-248-9720, fax: 716-248-9185.*
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OFF THE STACK

• **ProCentric Software's bitBlocker** ($495) protects electronic images against piracy. Most protection techniques use encryption or special formats to protect just the image files on disk. bitBlocker goes beyond disk protection to prevent end users from copying images from video memory. bitBlocker operates as a virtual device driver (VxD), and can be incorporated into any Windows-based application. *ProCentric Software; 818-706-1282; fax, 818-706-1283.*
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• **C-DOC Professional, Version 6.0** ($299), from Software Blacksmiths, documents C and C++ programs on Windows 3.1, Windows NT, DOS, and OS/2. Useful for making sense of poorly documented legacy code, it comprises six modules: C-CALL (cross references functions), C-CMT (adds comments), C-LIST (diagrams and aligns program listings), C-REF (cross-references identifiers), C-METRIC (provides counts), and C-BROWSE (provides graphical views of C-CALL and C-REF trees). *Software Blacksmiths Inc.; voice and fax, 905-858-4466.*
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Power Programming

BY JEFF PROSISE

Secondary Message Loops

The multitasking model used by 16-bit Windows is anything but optimal. If you're familiar with Windows' real-mode heritage and you know that it once would multitask even on an 8088-based computer, this comes as no surprise. Whereas Windows NT and the forthcoming Windows 95 distribute time among active processes preemptively, the Windows 3.1 scheduler relies on each running application to yield voluntarily to other applications. Yielding occurs when an application calls GetMessage to check its message queue for pending messages. The central figure in most Windows programs is a `while` loop that calls GetMessage repeatedly, so cooperative (or nonpreemptive) multitasking generally works pretty well.

The problem with cooperative multitasking is that if a single ill-behaved application goes for too long without checking for messages, other applications stop in their tracks. Even the application that causes the problem suffers, because the stoppage of message traffic renders an application incapable of responding to user input. Thus, the cooperative multitasking model is flawed, because it relies on every running application in the system to be a good citizen. One bad apple spoils the bunch.

The onus is on the programmer to keep the messages flowing. Suppose you're writing a program that scans every file on a hard disk for virus signatures. If the hard disk contains thousands of files, the scan could take several minutes. Go that long without dipping into the message queue, and your app will be a very poor neighbor. In 32-bit Windows, there's a simple and very elegant solution: multithreading. In this example, multithreading would let you delegate the job of scanning the hard disk to another thread. When the job's done, the thread ends. Meanwhile, the program's primary thread keeps things moving by continually retrieving messages from the message queue and processing them.

Windows 3.1 doesn't support multiple threads of execution, so the solution is quite different: a secondary message loop. A secondary message loop works like a pump to maintain the flow of messages. If it periodically used a secondary message loop to flush the message queue, the virus checker's disk-scan routine could take as much time as it needed to examine the files on the disk without adversely affecting other programs. If more programmers used secondary message loops, users would spend a lot less time staring at hourglass cursors: no more stopping and waiting for one program to finish what it's doing before switching to another.

Secondary message loops aren't something you read a lot about, but that doesn't mean they're not important. Almost every Windows programmer needs them at one time or another. I've always wondered why so few Windows programming books cover them—especially since there's a subtle aspect of implementing a secondary message loop that if overlooked, can result in an app that does more harm than good. To demonstrate the proper use of secondary message loops, we'll build three sample applications that draw thousands of ellipses on the screen. You'll see what happens when a program fails to check its message queue often enough, and what a properly written message loop looks like. More importantly, you'll learn how easy it is to turn a piggish program into a smooth multitasker by adding just a few lines of code.

MSGPUMP1 MSGPUMP1 is a simple program that draws ellipses of random colors and sizes. The core of the program is the DrawEllipse function, which uses C's `rand` function to generate a random bounding rectangle and RGB color and draws a filled ellipse using Windows' Ellipse API function. When the Start button is clicked, the program's WM_COMMAND message handler executes the following statements to draw 2,048 colored ellipses:

```
i = 0;
bContinue = TRUE;
while ((i++ < NUMELLIPSES) &&
       bContinue)
    DrawEllipse (hwnd);
```

On a 50-MHz 486 equipped with a fast 64-bit Windows accelerator, and in a window that encompasses roughly one-fourth of a 1,024-by-768 screen, MSGPUMP1 requires about 15 seconds to complete the `while` loop. Your actual mileage of course may vary depending on the speed of your hardware and the window size. (A larger window requires more drawing time because it contains more pixels.) The program's output is shown in Figure 1 and the source code appears in Figure 2 (You can download all the sample apps mentioned in this column from PC MagNet's Programming forum archived as MSGPUM.ZIP).

Any program that launches a time-consuming operation like this one should

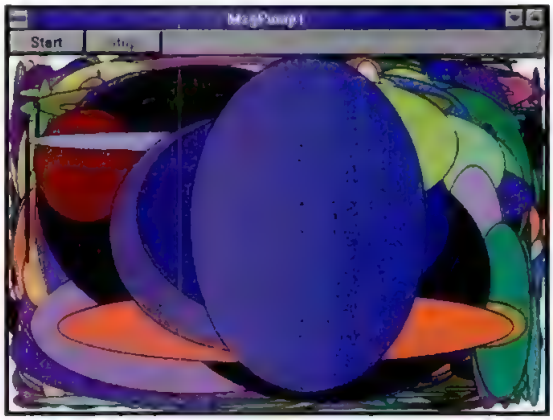
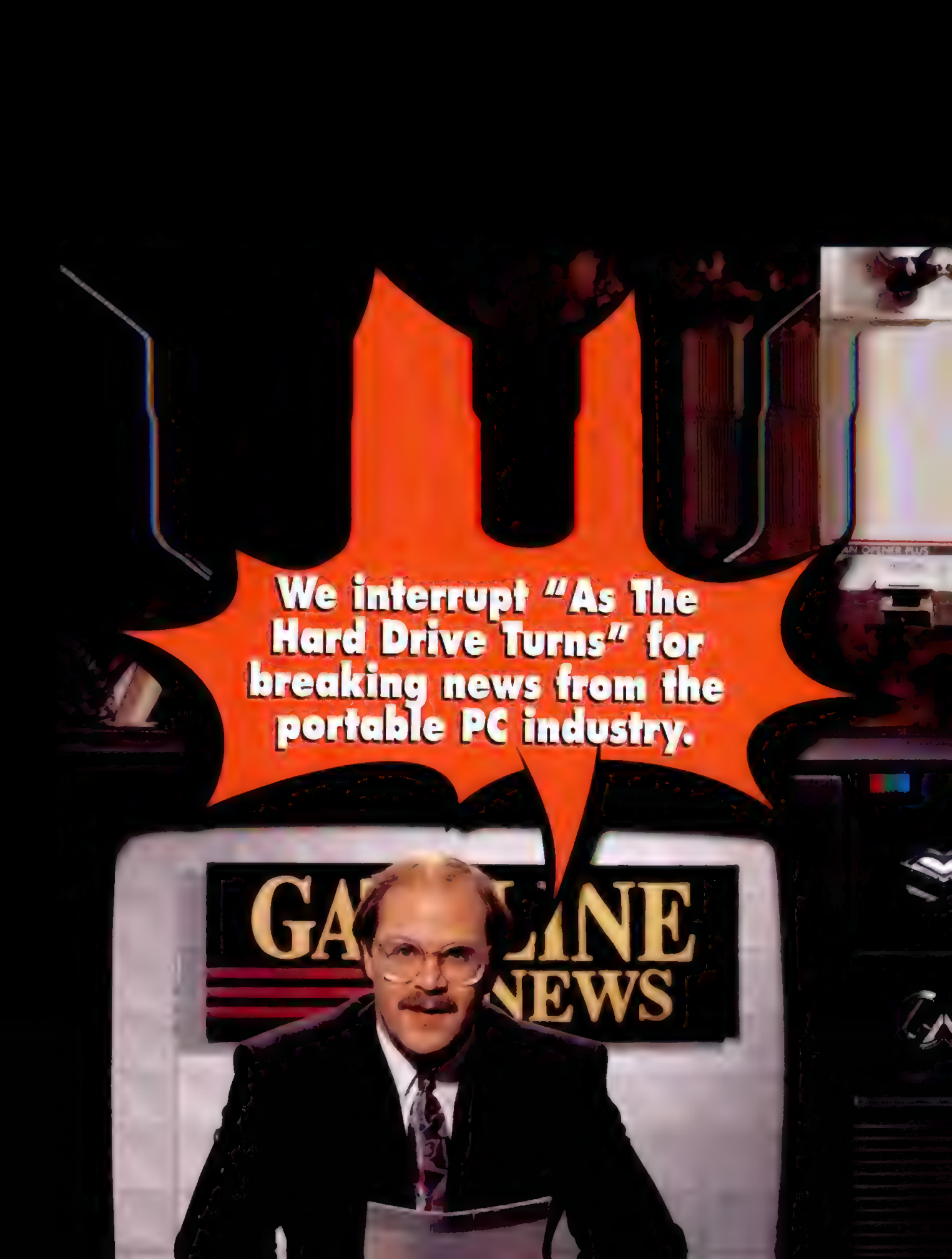
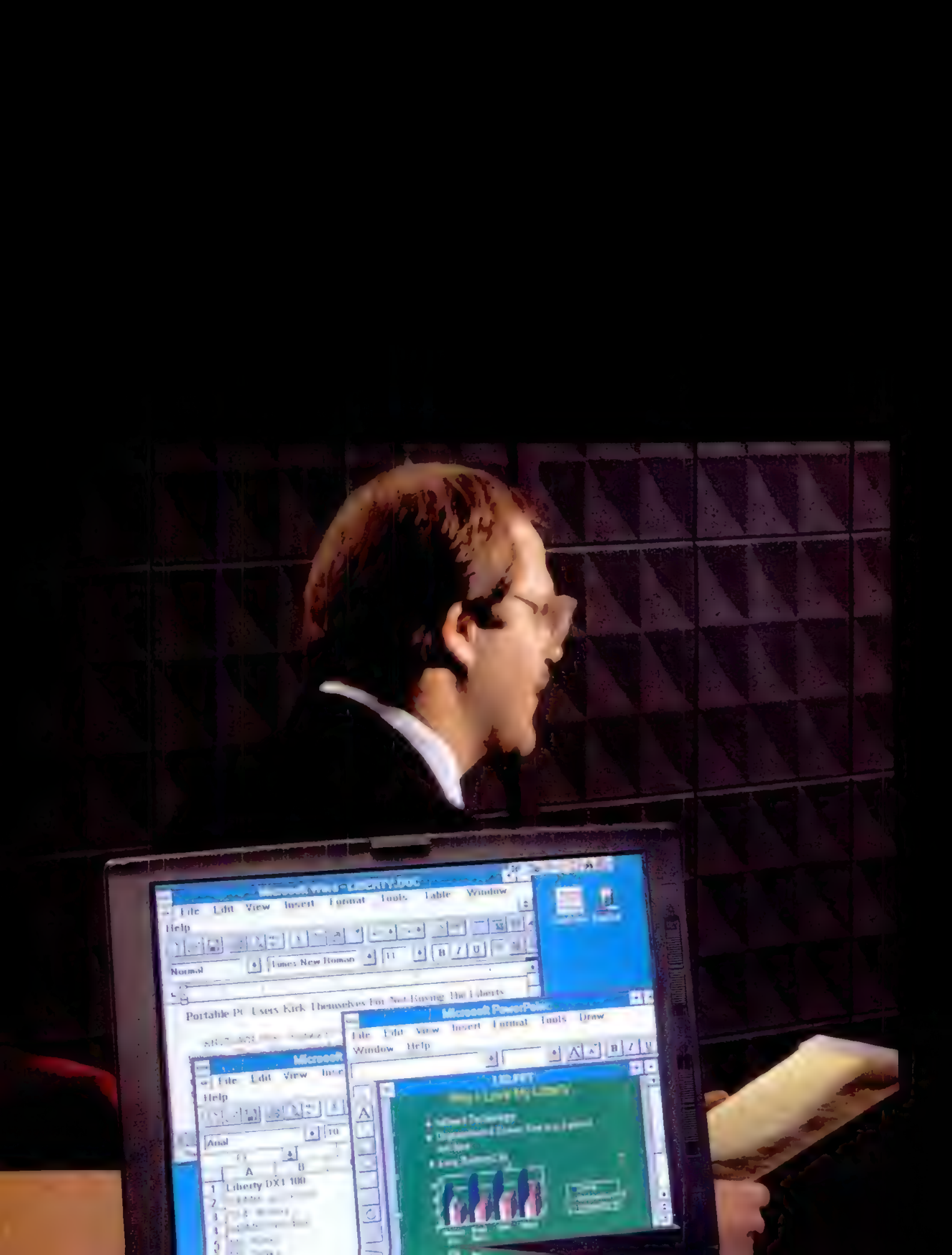


Figure 1: **When you press its Start button, MSGPUMP1 draws 2,048 randomly sized and colored ellipses.**

```
#define IDD_START       100
#define IDD_STOP        101
#define BUTTONWIDTH      72
#define BUTTONHEIGHT     24
#define NUMELLIPSES    2048

#include <windows.h>
#include <stdlib.h>
#include <time.h>

long FAR PASCAL WndProc (HWND, WORD, WORD, LONG);
void DrawEllipse (HWND);

/*
 *  WinMain starts the program.
 */

int PASCAL WinMain (HINSTANCE hInstance, HINSTANCE hPrevInstance,
                    LPSTR lpszCmdLine, int nCmdShow)
{
    static char szAppName[] = "MsgPump1";
    WNDCLASS wc;
    HWND hwnd;
    MSG msg;

    if (!hPrevInstance) {
        wc.style = CS_HREDRAW | CS_VREDRAW;
        wc.lpfnWndProc = (WNDPROC) WndProc;
        wc.cbClsExtra = 0;
        wc.cbWndExtra = 0;
        wc.hInstance = hInstance;
        wc.hIcon = LoadIcon (NULL, IDI_APPLICATION);
        wc.hCursor = LoadCursor (NULL, IDC_ARROW);
        wc.hbrBackground = COLOR_WINDOW + 1;
        wc.lpszMenuName = NULL;
        wc.lpszClassName = szAppName;

        RegisterClass (&wc);
    }

    hwnd = CreateWindow (szAppName, szAppName, WS_OVERLAPPEDWINDOW,
        CW_USEDEFAULT, CW_USEDEFAULT, CW_USEDEFAULT, CW_USEDEFAULT,
        NULL, NULL, hInstance, NULL);

    ShowWindow (hwnd, nCmdShow);
    UpdateWindow (hwnd);

    while (GetMessage (&msg, NULL, 0, 0)) {
        TranslateMessage (&msg);
        DispatchMessage (&msg);
    }

    return msg.wParam;
}

/*
 *  WndProc processes messages to the main window.
 */

long FAR PASCAL WndProc (HWND hwnd, WORD message, WORD wParam, LONG
                         lParam)
{
    HDC hdc;
    PAINTSTRUCT ps;
    static BOOL bContinue;
    RECT rect;
    UINT i;

    switch (message) {

    case WM_CREATE:
        //
        // Create the Start and Stop buttons and seed the random number
        // generator.
        //
        CreateWindow ("button", "Start",
            WS_CHILD | WS_VISIBLE | BS_PUSHBUTTON,
            0, 0, BUTTONWIDTH, BUTTONHEIGHT, hwnd, IDD_START,
            (HINSTANCE) ((LPCREATESTRUCT) lParam)->hInstance, NULL);

        CreateWindow ("button", "Stop",
            WS_CHILD | WS_VISIBLE | BS_PUSHBUTTON | WS_DISABLED,
            BUTTONWIDTH, 0, BUTTONWIDTH, BUTTONHEIGHT, hwnd, IDD_STOP,
            (HINSTANCE) ((LPCREATESTRUCT) lParam)->hInstance, NULL);

        srand ((unsigned) time (NULL));
        return 0;

    case WM_PAINT:
        //
        // Draw the background behind the push buttons.
        //
        hdc = BeginPaint (hwnd, &ps);
        GetClientRect (hwnd, &rect);
        rect.bottom = BUTTONHEIGHT;
        FillRect (hdc, &rect, (HBRUSH) GetStockObject (LTGRAY_BRUSH));
        MoveTo (hdc, 0, BUTTONHEIGHT);
        LineTo (hdc, rect.right, BUTTONHEIGHT);
        EndPaint (hwnd, &ps);
        return 0;

    case WM_COMMAND:
        //
        // Process push button messages.
        //
        switch (wParam)  {

        case IDD_START:
            //
            // Start drawing.
            //
            EnableWindow (GetDlgItem (hwnd, IDD_START), FALSE);
            EnableWindow (GetDlgItem (hwnd, IDD_STOP), TRUE);

            i = 0;
            bContinue = TRUE;

            while ((i++ < NUMELLIPSES) && bContinue)
                DrawEllipse (hwnd);

            EnableWindow (GetDlgItem (hwnd, IDD_START), TRUE);
            EnableWindow (GetDlgItem (hwnd, IDD_STOP), FALSE);
            return 0;

        case IDD_STOP:
            //
            // Stop drawing.
            //
            bContinue = FALSE;
            return 0;
        }
        break;

    case WM_DESTROY:
        //
        // Terminate the program.
        //
        PostQuitMessage (0);
        return 0;
    }
    return DefWindowProc (hwnd, message, wParam, lParam);
}

/*
 *  DrawEllipse draws an ellipse of an arbitrary size and color in the
 *  window's client area.
 *
 *  Input parameters:
 *    hwnd = Window handle
 *
 *  Returns:
 *    Nothing
 */

void DrawEllipse (HWND hwnd)
{
    RECT rect;
    HBRUSH hBrush;
    int x1, y1, x2, y2;
    HDC hdc;

    GetClientRect (hwnd, &rect);
    rect.bottom -= BUTTONHEIGHT;

    x1 = rand () % rect.right;
    x2 = rand () % rect.right;
    y1 = (rand () % rect.bottom) + BUTTONHEIGHT;
    y2 = (rand () % rect.bottom) + BUTTONHEIGHT;

    hBrush = CreateSolidBrush (RGB (rand () & 255, rand () & 255,
        rand () & 255));
    hdc = GetDC (hwnd);
    SelectObject (hdc, hBrush);

    Ellipse (hdc, min (x1, x2), min (y1, y2), max (x1, x2),
             max (y1, y2));

    ReleaseDC (hwnd, hdc);
    DeleteObject (hBrush);
}
```

Figure 2: **MSGPUMP1 is an example of an ill-behaved application that goes for too long without checking for messages.**


We interrupt "As The Hard Drive Turns" for breaking news from the portable PC industry.


File Edit View Insert Format Tools Table Window
Help
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Portable PC Users Kick Themselves For Not Having The Liberty
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Liberty DX1 100

Reporter: We have an exclusive interview today with a person who wishes to be identified only as John Doe. Now tell me John, is it true you purchased a portable PC from one of those "other" companies?

John Doe: Yes sir. I'm afraid it is. I'm so foolish. I settled for a portable PC with a tiny 8.4-inch screen, a 250MB hard drive and minimum software applications. It sounded good at the time, but that was before I knew about the 4.2-pound Liberty™ from Gateway 2000.® Its impressive 10.4-inch screen has 53 percent more active viewing area than the 8.4-inch screen and it features amazing infrared technology that lets you use many cool IR features including wireless transfer. I'll still be transferring files with those darn cables while Liberty users can simply beam files back and forth between their desktop PC or another Liberty. Plus, the Liberty DX4-100 Best Buy has a powerful 100MHz processor combined with a massive 720MB removable hard drive, 24MB RAM, a TelePath™ 14.4 XJACK® fax/modem, leather carrying case and Microsoft® Office Professional. How could I have been such a sap? I relish the thought of having a Liberty for about the same price. Now I have to enroll in the Portable PC Protection Program and start a new life. If only I had gotten the Liberty from Gateway 2000!

Reporter: Well, there you have it. This is just one of many portable PC buyers distraught because they bought a PC from one of the "other" companies. Remember, the Liberty is the latest and greatest development in portable computing. Unless you want to end up like this poor fellow, don't settle for anything less than a Liberty from Gateway 2000. Call them today! We now return to "As The Hard Drive Turns."

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provide a way to stop the procedure once it is started. To that end, MSGPUMP1's toolbar includes a Stop button as well as a Start button. When clicked, the Stop button causes the following statement to be executed:

```
bContinue = FALSE;
```

The `while` loop that draws the ellipses tests the value of bContinue at the beginning of every iteration and terminates if bContinue is FALSE. Therefore, the mere act of setting bContinue to FALSE is sufficient to stop drawing at any time.

What happens if you click the Stop button as ellipses are being drawn? If you try it, you'll find that nothing happens; MSGPUMP1 keeps right on drawing. During the 15 seconds or so it takes the `while` loop to run from start to finish, not a single message is retrieved from the message queue. The execution of the statement that sets bContinue to FALSE when Stop is clicked is dependent upon the receipt and processing of a WM_COMMAND message, so MSGPUMP1's failure to check the message queue effectively disables the Stop button. It doesn't look disabled; the text on the button face isn't grayed out like a normal disabled button. But ignoring messages from a control amounts to little more than disabling the control.

You'll also find that nothing else in the MSGPUMP1 window works while ellipses are being drawn. You can't, for example, terminate the program by double-clicking the system menu box. Nor can you maximize the window by clicking the maximize button. (Either action will have the intended effect, but only after drawing is complete. The messages commanding the application to terminate or maximize will languish in the message queue until they can be retrieved.) As long as messages aren't being retrieved from the message queue, the program is unwilling—and in fact unable—to respond to input.

A few seconds might not seem so bad, but what if seconds stretched into minutes? What if MSGPUMP1 drew 20,000 ellipses instead of 2,048? It's bad enough that input to the program is effectively disabled for the duration. But MSGPUMP1's inability to accept input is symptomatic of a bigger problem. To illustrate, click on MSGPUMP1's Start button to start the ellipse-drawing loop and then try switching to another program. Until MSGPUMP1 finishes drawing the 2,048th ellipse, it's impossible to activate another window.

This might seem surprising at first, because every Windows application has its own application message queue; theoretically, one application's failure to process messages shouldn't affect other applications. The problem, of course, is that mouse and keyboard events go through the system message queue, and there's only one system message queue, which is shared by every program in the system. One program's failure to retrieve mouse and keyboard messages from the system message queue prevents other programs from doing the same. Even if the other programs could retrieve messages, it would do them little good, since they're not being allocated any CPU time.

```
#define IDD_START       100
#define IDD_STOP        101
#define BUTTONWIDTH      72
#define BUTTONHEIGHT     24
#define NUMELLIPSES    2048

#include <windows.h>
#include <stdlib.h>
#include <time.h>

long FAR PASCAL WndProc (HWND, WORD, WORD, LONG);
void DrawEllipse (HWND);
void CheckMessageQueue (void);

/*
 *  WinMain starts the program.
 */

int PASCAL WinMain (HINSTANCE hInstance, HINSTANCE hPrevInstance,
                    LPSTR lpszCmdLine, int nCmdShow)
{
    static char szAppName[] = "MsgPump2";
    WNDCLASS wc;
    HWND hwnd;
    MSG msg;

    if (!hPrevInstance) {
        wc.style = CS_HREDRAW | CS_VREDRAW;
        wc.lpfnWndProc = (WNDPROC) WndProc;
        wc.cbClsExtra = 0;
        wc.cbWndExtra = 0;
        wc.hInstance = hInstance;
        wc.hIcon = LoadIcon (NULL, IDI_APPLICATION);
        wc.hCursor = LoadCursor (NULL, IDC_ARROW);
        wc.hbrBackground = COLOR_WINDOW + 1;
        wc.lpszMenuName = NULL;
        wc.lpszClassName = szAppName;

        RegisterClass (&wc);
    }

    hwnd = CreateWindow (szAppName, szAppName, WS_OVERLAPPEDWINDOW,
        CW_USEDEFAULT, CW_USEDEFAULT, CW_USEDEFAULT, CW_USEDEFAULT,
        NULL, NULL, hInstance, NULL);

    ShowWindow (hwnd, nCmdShow);
    UpdateWindow (hwnd);

    while (GetMessage (&msg, NULL, 0, 0)) {
        TranslateMessage (&msg);
        DispatchMessage (&msg);
    }

    return msg.wParam;
}

/*
 *  WndProc processes messages to the main window.
 */

long FAR PASCAL WndProc (HWND hwnd, WORD message, WORD wParam,
                         LONG lParam)
{
    HDC hdc;
    PAINTSTRUCT ps;
    static BOOL bContinue;
    RECT rect;
    UINT i;

    switch (message) {

    case WM_CREATE:
        //
        // Create the Start and Stop buttons and seed the random number
        // generator.
        //
        CreateWindow ("button", "Start",
            WS_CHILD | WS_VISIBLE | BS_PUSHBUTTON,
            0, 0, BUTTONWIDTH, BUTTONHEIGHT, hwnd, IDD_START,
            (HINSTANCE) ((LPCREATESTRUCT) lParam)->hInstance, NULL);

        CreateWindow ("button", "Stop",
            WS_CHILD | WS_VISIBLE | BS_PUSHBUTTON | WS_DISABLED,
            BUTTONWIDTH, 0, BUTTONWIDTH, BUTTONHEIGHT, hwnd, IDD_STOP,
            (HINSTANCE) ((LPCREATESTRUCT) lParam)->hInstance, NULL);

        srand ((unsigned) time (NULL));
        return 0;

    case WM_PAINT:
        //
        // Draw the background behind the push buttons.
        //
        hdc = BeginPaint (hwnd, &ps);
        GetClientRect (hwnd, &rect);
        rect.bottom = BUTTONHEIGHT;
        FillRect (hdc, &rect, (HBRUSH) GetStockObject (LTGRAY_BRUSH));
        MoveTo (hdc, 0, BUTTONHEIGHT);
        LineTo (hdc, rect.right, BUTTONHEIGHT);
        EndPaint (hwnd, &ps);
        return 0;
```

CONTINUED ON NEXT PAGE

Figure 3: **MSGPUMP2 uses a secondary message loop to keep the messages flowing while the window is being filled with ellipses.**

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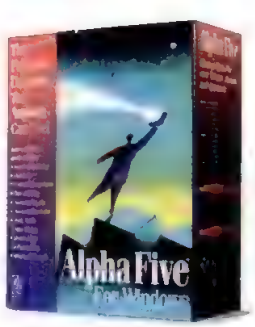

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```
case WM_COMMAND:
    //
    // Process push button messages.
    //
    switch (wParam)  {

    case IDD_START:
        //
        // Start drawing.
        //
        EnableWindow (GetDlgItem (hwnd, IDD_START), FALSE);
        EnableWindow (GetDlgItem (hwnd, IDD_STOP), TRUE);

        i = 0;
        bContinue = TRUE;

        while ((i++ < NUMELLIPSES) && bContinue) {
            DrawEllipse (hwnd);
            CheckMessageQueue ();
        }

        EnableWindow (GetDlgItem (hwnd, IDD_START), TRUE);
        EnableWindow (GetDlgItem (hwnd, IDD_STOP), FALSE);
        return 0;

    case IDD_STOP:
        //
        // Stop drawing.
        //
        bContinue = FALSE;
        return 0;
    }
    break;

case WM_DESTROY:
    //
    // Terminate the program.
    //
    PostQuitMessage (0);
    return 0;
}
return DefWindowProc (hwnd, message, wParam, lParam);
}

/*
 *  DrawEllipse draws an ellipse of an arbitrary size and color in the
 *  window's client area.
 *
 *  Input parameters:
 *    hwnd = Window handle
 *
 *  Returns:
 *    Nothing
 */

void DrawEllipse (HWND hwnd)
{
    RECT rect;
    HBRUSH hBrush;
    int x1, y1, x2, y2;
    HDC hdc;

    GetClientRect (hwnd, &rect);
    rect.bottom -= BUTTONHEIGHT;

    x1 = rand () % rect.right;
    x2 = rand () % rect.right;
    y1 = (rand () % rect.bottom) + BUTTONHEIGHT;
    y2 = (rand () % rect.bottom) + BUTTONHEIGHT;

    hBrush = CreateSolidBrush (RGB (rand () & 255, rand () & 255,
        rand () & 255));
    hdc = GetDC (hwnd);
    SelectObject (hdc, hBrush);

    Ellipse (hdc, min (x1, x2), min (y1, y2), max (x1, x2),
            max (y1, y2));

    ReleaseDC (hwnd, hdc);
    DeleteObject (hBrush);
}

/*
 *  CheckMessageQueue retrieves and dispatches any messages waiting in
 *  the application's message queue.
 *
 *  Input parameters:
 *    None
 *
 *  Returns:
 *    Nothing
 */

void CheckMessageQueue (void)
{
    MSG msg;

    while (PeekMessage (&msg, NULL, 0, 0, PM_REMOVE)) {
        TranslateMessage (&msg);
        DispatchMessage (&msg);
    }
}
```

It's evident from MSGPUMP1 how one badly behaved app can bring the rest of the system to a grinding, if only temporary, halt. At the very least, we should modify MSGPUMP1 to display an hourglass cursor while the `while` loop runs its course. But an hourglass is only a visual reminder that a time-consuming operation is under way. It does nothing to mitigate the problem. And only a very unfriendly program displays an hourglass for extended periods of time and prevents the user from doing anything else. That's why secondary message loops are so important.

ADDING A SECONDARY MESSAGE LOOP

MSGPUMP1's deficiencies are easily fixed by adding a secondary message loop, as shown in Figure 3's MSGPUMP2. The only difference between MSGPUMP1 and MSGPUMP2 is the latter's use of a function named CheckMessageQueue, which is called from the `while` loop that draws the ellipses:

```
i = 0;
bContinue = TRUE;

while ((i++ < NUMELLIPSES) &&
       bContinue) {
    DrawEllipse (hwnd);
    CheckMessageQueue ();
}
```

CheckMessageQueue itself comprises just a few lines of code:

```
while (PeekMessage (&msg, NULL, 0, 0,
       PM_REMOVE)) {
    TranslateMessage (&msg);
    DispatchMessage (&msg);
}
```

Just like the main message loop in WinMain, the secondary message loop in CheckMessageQueue loops continually, retrieves messages, and dispatches them to the program's window procedure. The difference is what happens when there are no more messages waiting in the queue.

The GetMessage call in the main message loop doesn't return until a message becomes available. The PeekMessage call in the secondary message loop returns to the caller immediately, whether there's a message to be retrieved or not. Therefore, the secondary message loop will never "block" on an empty message queue. Just as important, PeekMessage yields CPU time to other active processes just as GetMessage does.

The net effect of all this is that calling CheckMessageQueue when the message queue is empty yields CPU time to other programs, which makes for smoother multitasking among programs. When messages are waiting, the call yields CPU time and results in those messages being retrieved, dispatched, and processed. This allows the program to be responsive to input and prevents the system message queue from becoming clogged. One simple change reforms the program into a model citizen.

You can see just how much better behaved MSGPUMP2 is by running it and clicking on its Start button. To stop the ellipses at any time, just click on Stop. Here's why it works: After drawing each ellipse, the `while` loop that drives the ellipse output calls CheckMessageQueue.

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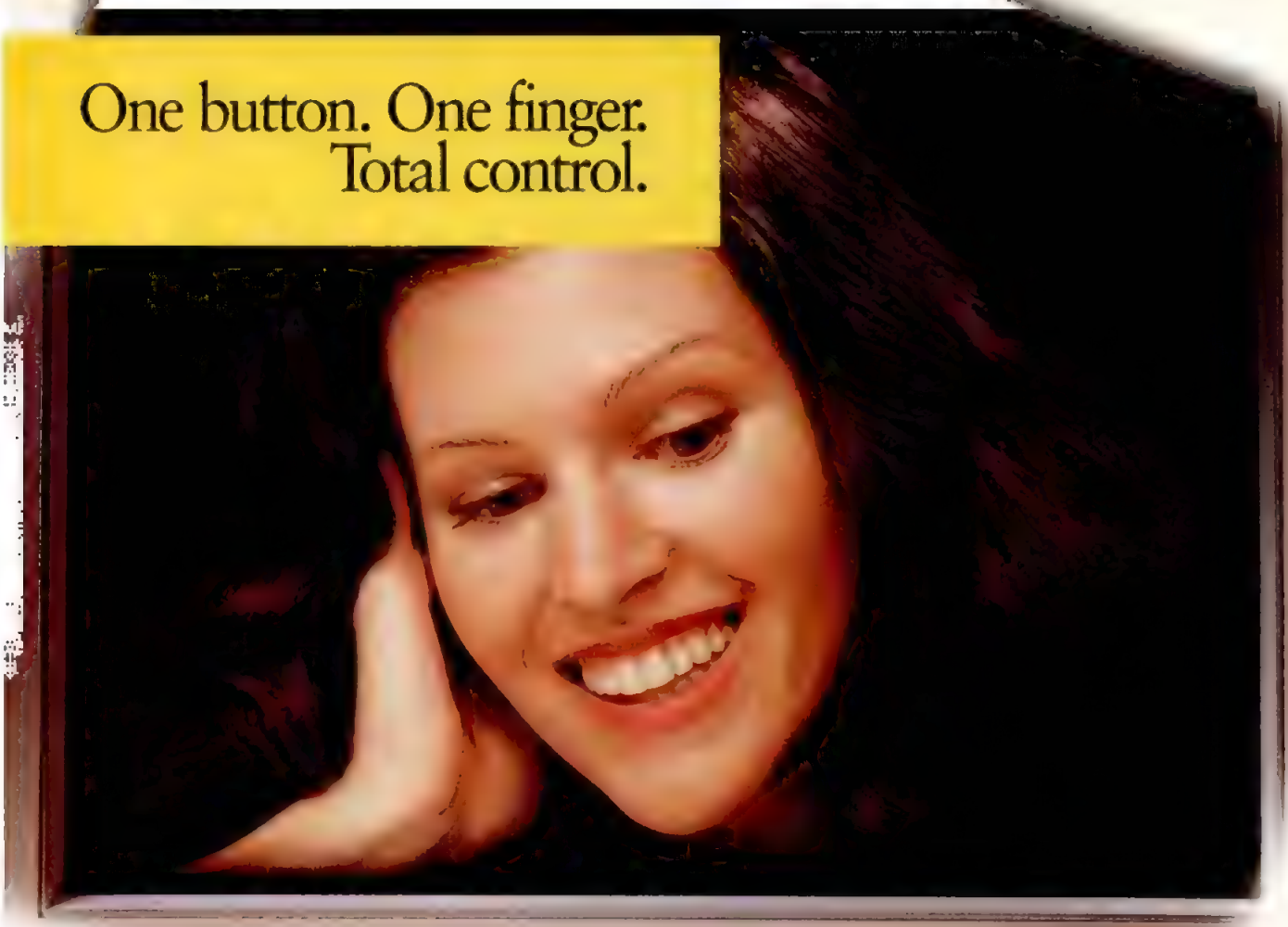

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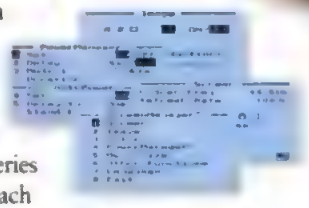

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Remember that this `while` loop falls through when NUMELLIPSES ellipses have been drawn or when bContinue changes from TRUE to FALSE. If the Stop button was clicked, a WM_COMMAND message with wParam equal to IDD_STOP will be waiting in the message queue. CheckMessageQueue retrieves and dispatches the message, and the message handler sets bContinue to FALSE. When CheckMessageQueue returns and the `while` loop circles back for another round, it immediately terminates because of the new value of bContinue. The Stop button now works as intended.

You can also demonstrate that MSGPUMP2 is an efficient multitasker by running two or more instances of it at once. Two instances running side by side draw ellipses almost as efficiently as a single instance. Significantly, neither instance exhibits perceptible stops and starts—an outward sign that both programs are yielding processor time frequently and on a regular basis. For a stark contrast, call up one instance each of MSGPUMP1 and MSGPUMP2 and click the Start button in MSGPUMP2 followed by the Start button in MSGPUMP1. MSGPUMP2 will be suspended while MSGPUMP1 draws its ellipses—a graphic illustration of what happens when a Windows application doesn't yield the processor as often as it should.

MSGPUMP2 offers dramatic improvement over its predecessor, but one problem remains: the CheckMessageQueue function contains a very serious error. Can you spot it?

FIXING THE MESSAGE LOOP The problem with CheckMessageQueue is that it lacks the special logic required to handle WM_QUIT messages. Look back for a moment at MSGPUMP2's main message loop. Located in WinMain, it is much like the main message loop used in thousands of Windows programs:

```
while (GetMessage (&msg, NULL, 0, 0)) {
    TranslateMessage (&msg);
    DispatchMessage (&msg);
}
```

```
#define IDD_START       100
#define IDD_STOP        101
#define BUTTONWIDTH      72
#define BUTTONHEIGHT     24
#define NUMELLIPSES    2048

#include <windows.h>
#include <stdlib.h>
#include <time.h>

long FAR PASCAL WndProc (HWND, WORD, WORD, LONG);
void DrawEllipse (HWND);
BOOL CheckMessageQueue (void);

/*
 *  WinMain starts the program.
 */

int PASCAL WinMain (HINSTANCE hInstance, HINSTANCE hPrevInstance,
                    LPSTR lpszCmdLine, int nCmdShow)
{
    static char szAppName[] = "MsgPump3";
    WNDCLASS wc;
    HWND hwnd;
    MSG msg;

    if (!hPrevInstance) {
        wc.style = CS_HREDRAW | CS_VREDRAW;
        wc.lpfnWndProc = (WNDPROC) WndProc;
        wc.cbClsExtra = 0;
        wc.cbWndExtra = 0;
        wc.hInstance = hInstance;
        wc.hIcon = LoadIcon (NULL, IDI_APPLICATION);
        wc.hCursor = LoadCursor (NULL, IDC_ARROW);
        wc.hbrBackground = COLOR_WINDOW + 1;
        wc.lpszMenuName = NULL;
        wc.lpszClassName = szAppName;

        RegisterClass (&wc);
    }

    hwnd = CreateWindow (szAppName, szAppName, WS_OVERLAPPEDWINDOW,
        CW_USEDEFAULT, CW_USEDEFAULT, CW_USEDEFAULT, CW_USEDEFAULT,
        NULL, NULL, hInstance, NULL);

    ShowWindow (hwnd, nCmdShow);
    UpdateWindow (hwnd);

    while (GetMessage (&msg, NULL, 0, 0)) {
        TranslateMessage (&msg);
        DispatchMessage (&msg);
    }

    return msg.wParam;
}

/*
 *  WndProc processes messages to the main window.
 */

long FAR PASCAL WndProc (HWND hwnd, WORD message, WORD wParam,
                         LONG lParam)
{
    HDC hdc;
    PAINTSTRUCT ps;
    static BOOL bContinue;
    RECT rect;
    UINT i;

    switch (message) {

    case WM_CREATE:
        //
        // Create the Start and Stop buttons and seed the random number
        // generator.
        //
        CreateWindow ("button", "Start",
            WS_CHILD | WS_VISIBLE | BS_PUSHBUTTON,
            0, 0, BUTTONWIDTH, BUTTONHEIGHT, hwnd, IDD_START,
            (HINSTANCE) ((LPCREATESTRUCT) lParam)->hInstance, NULL);

        CreateWindow ("button", "Stop",
            WS_CHILD | WS_VISIBLE | BS_PUSHBUTTON | WS_DISABLED,
            BUTTONWIDTH, 0, BUTTONWIDTH, BUTTONHEIGHT, hwnd, IDD_STOP,
            (HINSTANCE) ((LPCREATESTRUCT) lParam)->hInstance, NULL);

        srand ((unsigned) time (NULL));
        return 0;

    case WM_PAINT:
        //
        // Draw the background behind the push buttons.
        //
        hdc = BeginPaint (hwnd, &ps);
        GetClientRect (hwnd, &rect);
        rect.bottom = BUTTONHEIGHT;
        FillRect (hdc, &rect, (HBRUSH) GetStockObject (LTGRAY_BRUSH));
        MoveTo (hdc, 0, BUTTONHEIGHT);
        LineTo (hdc, rect.right, BUTTONHEIGHT);
        EndPaint (hwnd, &ps);
        return 0;

    case WM_COMMAND:
        //
        // Process push button messages.
        //
        switch (wParam)  {

        case IDD_START:
            //
            // Start drawing.
            //
            EnableWindow (GetDlgItem (hwnd, IDD_START), FALSE);
            EnableWindow (GetDlgItem (hwnd, IDD_STOP), TRUE);

            i = 0;
            bContinue = TRUE;

            while ((i++ < NUMELLIPSES) && bContinue) {
                DrawEllipse (hwnd);
                if (!CheckMessageQueue ())
                    break;
            }

            EnableWindow (GetDlgItem (hwnd, IDD_START), TRUE);
            EnableWindow (GetDlgItem (hwnd, IDD_STOP), FALSE);
            return 0;

        case IDD_STOP:
            //
            // Stop drawing.
            //
            bContinue = FALSE;
            return 0;
```

CONTINUED ON NEXT PAGE

***Figure 4:* MSGPUMP3 corrects the deficiency in MSGPUMP2's secondary message loop by adding special logic for handling WM_QUIT messages.**

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CIRCLE 126 ON READER SERVICE CARD

```
        }
        break;

    case WM_DESTROY:
        //
        // Terminate the program.
        //
        PostQuitMessage (0);
        return 0;
    }
    return DefWindowProc (hwnd, message, wParam, lParam);
}

/*
 *  DrawEllipse draws an ellipse of an arbitrary size and color in the
 *  window's client area.
 *
 *  Input parameters:
 *    hwnd = Window handle
 *
 *  Returns:
 *    Nothing
 */

void DrawEllipse (HWND hwnd)
{
    RECT rect;
    HBRUSH hBrush;
    int x1, y1, x2, y2;
    HDC hdc;

    GetClientRect (hwnd, &rect);
    rect.bottom -= BUTTONHEIGHT;

    x1 = rand () % rect.right;
    x2 = rand () % rect.right;
    y1 = (rand () % rect.bottom) + BUTTONHEIGHT;
    y2 = (rand () % rect.bottom) + BUTTONHEIGHT;

    hBrush = CreateSolidBrush (RGB (rand () & 255, rand () & 255,
        rand () & 255));
    hdc = GetDC (hwnd);
    SelectObject (hdc, hBrush);

    Ellipse (hdc, min (x1, x2), min (y1, y2), max (x1, x2),
             max (y1, y2));

    ReleaseDC (hwnd, hdc);
    DeleteObject (hBrush);
}

/*
 *  CheckMessageQueue retrieves and dispatches any messages waiting in
 *  the application's message queue. WM_QUIT messages are NOT removed
 *  from the queue.
 *
 *  Input parameters:
 *    None
 *
 *  Returns:
 *    TRUE = Message queue empty; okay to continue
 *    FALSE = WM_QUIT waiting in queue
 */

BOOL CheckMessageQueue (void)
{
    MSG msg;

    while (PeekMessage (&msg, NULL, 0, 0, PM_NOREMOVE)) {
        if (msg.message == WM_QUIT)
            return FALSE;
        else {
            GetMessage (&msg, NULL, 0, 0);
            TranslateMessage (&msg);
            DispatchMessage (&msg);
        }
    }
    return TRUE;
}
```

The `while` loop executes repeatedly until GetMessage returns 0, which only happens when GetMessage retrieves a WM_QUIT message signaling that it's time to quit. When the `while` loop falls through, a return statement is executed that ends WinMain and ultimately ends the program. The only way this program can be terminated is for the call to GetMessage in the main message loop to retrieve a WM_QUIT message. If that message is somehow skipped, or if it is retrieved by a secondary message loop, the program will never end.

Consider the following scenario. MSGPUMP2 is merrily chugging along drawing ellipses, when the user selects Close from the system menu. This action ultimately activates the program's WM_DESTROY handler, which calls PostQuitMessage to post a WM_QUIT message to the message queue. If CheckMessageQueue is called before the main message loop is allowed another iteration (and this will be the case if the program is drawing ellipses), the WM_QUIT message will be removed from the queue and dispatched to the program's window procedure by the message loop inside CheckMessageQueue. MSGPUMP2 will appear to terminate because its window goes away. But in reality, it's still an active task as far as Windows is concerned. WinMain and the main message loop remain behind in memory and continue to consume both memory and processing time. (If you have a debugger that lists the contents of Windows' internal task database, you can verify this by closing MSGPUMP2 while it's drawing ellipses and checking the task list. MSGPUMP2 will still be there, even though there's no visible evidence of it on the screen.) This frequently results in system instability and mysterious program crashes.

CheckMessageQueue is easily fixed by adding special handling code for WM_QUIT messages. MSGPUMP3, shown in Figure 4, illustrates how. Its version of CheckMessageQueue is slightly different from the one used by MSGPUMP2:

```
while (PeekMessage (&msg, NULL, 0, 0,
        PM_NOREMOVE)) {
    if (msg.message == WM_QUIT)
        return FALSE;
    else {
        GetMessage (&msg, NULL, 0, 0);
        TranslateMessage (&msg);
        DispatchMessage (&msg);
    }
}
return TRUE;
```

Now CheckMessageQueue explicitly checks for WM_QUIT messages and immediately returns FALSE if the next message in the queue is WM_QUIT. PeekMessage no longer retrieves messages from the queue; because it is invoked with a PM_NOREMOVE parameter, it simply returns a copy of the next message. This allows CheckMessageQueue to identify WM_QUIT messages without actually retrieving them. If the message queue is empty, CheckMessageQueue immediately returns TRUE (after the Windows scheduler has allotted processing time to other active processes, of course). If a message is waiting and it's anything but WM_QUIT, it is retrieved and dispatched by GetMessage. When the queue is emptied of messages, CheckMessageQueue returns TRUE. A FALSE return value, therefore, is a clear signal that a WM_QUIT message awaits processing in the message queue.

The one other change to MSGPUMP3 is the `while` loop that draws ellipses. It now checks the value returned by CheckMessageQueue and breaks out if that value is FALSE:

```
i = 0;
bContinue = TRUE;
while ((i++ < NUMELLIPSES) &&
       bContinue) {
```

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CIRCLE 084 ON READER SERVICE CARD

```
    DrawEllipse (hwnd);
    if (!CheckMessageQueue ())
        break;
}
```

This terminates the drawing process and immediately returns control to the main message loop, which then handles the WM_QUIT message properly. The `while` loop may now be broken by a click of the Stop button, which toggles bContinue from TRUE to FALSE, or by the posting of a WM_QUIT message to the message queue.

MSGPUMP3 demonstrates the proper use and implementation of secondary message loops. It multitasks efficiently because it never goes for more than a fraction of a second without checking the message queue, even when drawing ellipses. And because waiting messages are continually retrieved and dispatched as ellipses are drawn, MSGPUMP3 is responsive to input. Just as importantly, if you time MSGPUMP1 and MSGPUMP3 running on the same PC in equal-sized windows, you'll find that the secondary message loop has no measurable impact on performance; MSGPUMP3 draws every bit as quickly as MSGPUMP1. PeekMessage returns very quickly when there are no messages waiting in the queue and other applications aren't demanding processor time, so you needn't fear that a secondary message loop will slow your program down.

WHAT ABOUT WIN32? Earlier, I mentioned that you can avoid secondary message loops in Win32 applications by performing time-consuming operations in separate threads. But what if it's not convenient to create a second thread? Are secondary message loops necessary in an environment in which programs are multitasked preemptively rather than cooperatively? How would MSGPUMP1 behave if it were rewritten to run under Windows NT or Windows 95, using neither a second thread of execution nor a secondary message loop?

A version of MSGPUMP1 rewritten for Win32 would work better than the Win16 version, but it still wouldn't work as well as the Win16 version of MSGPUMP3. You could freely switch to other applications while MSGPUMP1 was running because both Windows NT and Windows 95 use desynchronized input queues, which means that each application gets its own system message queue as well as its own application message queue. But not even the Win32 version of MSGPUMP1 would respond to the Stop button. For that, you would still need either a secondary message loop or another thread.

In summary, secondary message loops are useful in both 16-bit and 32-bit Windows. But they're probably more useful in Win16 applications, where you don't have the option of moving time-consuming processes to separate threads. The next time you write an application that takes more than a few seconds to perform a certain task, consider streamlining the program's operation with a secondary message loop. □

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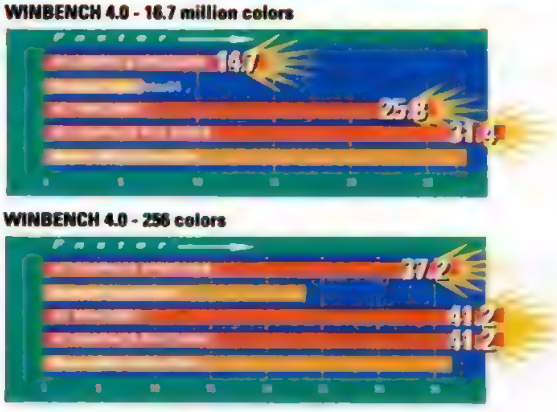

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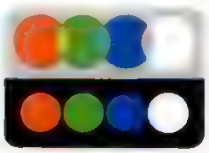

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CIRCLE 118 ON READER SERVICE CARD

Utilities

BY JOHN MCSORLEY

1MBFort Protects Low Memory

Have you ever seen the Windows error message that says "Insufficient memory to run this application" when only a few programs were open, so you were certain that there was plenty of available memory? There are several possible causes for this message, but one of the most common is a lack of low memory—that is, the memory below 1MB. This issue's utility, 1MBFort, solves this problem by, in effect, building a fortress to protect low memory.

But how do you know if you have the problem? After developing 1MBFort, I discovered the Microsoft Developer's Network (MSDN) CD—an invaluable tool for Windows programmers. In addition to the Microsoft Knowledge Base, which documents the problem that 1MBFort solves, the MSDN CD contains a useful utility written by Matt Pietrek called BELOW1MB, which lets nontechnical users check to see whether they are close to having the problem that 1MBFort solves. I wrote an adaptation of Pietrek's utility called View1MB as a companion utility for 1MBFort.

1MBFort and View1MB are available by mail or from PC MagNet archived as 1MBF.ZIP. The details are explained in the sidebar "Guide to Our Utilities and How to Get Them." 1MBFort is written in C; View1MB is written in Visual Basic.

CHECKING MEMORY WITH VIEW-1MB View1MB is simple to install and use. Just copy VIEW-1MB.EXE into a directory on your hard disk. Then use Program Manager to place an icon for it in one of your groups. Since View1MB was written in Visual Basic 3.0, you must also have the Visual Basic runtime, VBRUN-300.DLL, in your Windows SYSTEM directory (usually C:\WINDOWS\SYSTEM). View1MB also requires Microsoft's TOOLHELP.DLL to be in your Windows SYSTEM directory. Windows 3.1 users should already have this installed, but View1MB includes it for any Windows 3.0 users.

To start View1MB, double-click on its icon. You will get a dialog box similar to the one shown in Figure 1. The left list box displays the Free Blocks below 1MB; column 1 is the hexadecimal address, and column 2 is the hexadecimal size in bytes. Displayed below the left list box is the total number of free bytes below 1MB in hexadecimal and decimal.

The right list box displays the Used Blocks below 1MB; column 1 is the hexadecimal address, column 2 is the hexadecimal size in bytes, and column 3 describes the owner of the block. The owner is usually the module name minus the file type. Also displayed are the type of block (Data, DGroup, Code, etc.) and whether block is Locked or Fixed. Note that TDBs are displayed as "Task".

The Refresh button refreshes the two list boxes, and is useful when new programs have been launched since View1MB was loaded. To see how much memory is used by selected tasks—for example, all the blocks used by DISPLAY.DRV or another application, highlight the tasks and click on the Add button. A message box will describe the number of items selected and the total bytes used.

The problem 1MBFort fixes occurs more often with custom applications or applications from small vendors (many VBXs are sold by small companies). If you stick to applications from major software vendors, View1MB will likely tell you that you have plenty of memory below 1MB.

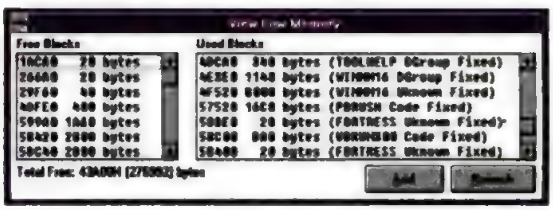

Figure 1: **View1MB lets you analyze low memory—memory below 1MB—by providing information about free and allocated blocks.**

USING 1MBFORT 1MBFort is simple to install and use. Just copy 1MBFORT.EXE into a directory on your hard disk. 1MBFort then can be installed in one of two ways: by creating an icon in the Startup group, or by adding 1MBFORT.EXE to the Load= line of WIN.INI. The second method is preferable, since it ensures that 1MBFort is the first application started, thus protecting conventional memory before other programs are loaded.

When 1MBFort is launched, you will not see a window or a minimized icon. But you can see that 1MBFort is running by bringing up Windows Task Manager (see Figure 2). You do this by double-clicking on the desktop, pressing Ctrl-Esc, or selecting the "Switch To. . ." option from the system menu of any running application.

1MBFort works by fragmenting low memory, memory below 1MB, so pro-

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3	**INCTRL** - *Controls Windows installation*
4	**FINDIR** - *IRQ line analysis*
5	**PCMKEY** - *Command line editor*
6	**BUGS** - *Windows 3.1 screen saver*
7	**PASTE** - *Enhanced Windows clipboard*
8	**WPNTR** - *Highlights Windows presentations*
9	**MYGRPS** - *Customizes group icons*
10	**WINCMD** - *Command file interpreter*

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grams cannot use large blocks of it. (Details on why this solves the problem appear below.) Next to 1MBFort's name in the Task Manager list you will see the size and number of the memory fragments created by the program. The default size of the fragments is approximately 10K. This usually works fine, but you can change it if necessary. To use a different fragment size, use Windows NotePad or another plain-text editor to edit the file called 1MBFORT.INI in your Windows directory. The block size specification has the following format:

```
[1MBFORT]
BlockSize = nnnnn
```

where *nnnnn* is in the range 5000 to 20000 and indicates the block size 1MBFort uses in bytes. (Do not insert commas in the number.) If you enter a value below 5000, 1MBFort changes it to 5000. Likewise, values above 20000 are converted to 20000.

The 5,000-byte lower limit was arrived at empirically. During testing I found that when the block size was below 5,000, Windows became unstable and General Protection Faults (GPFs) occurred intermittently. If the block size is set too high, the problem will not go away.

1MBFort can be terminated from within Task Manager by selecting it and pressing the End Task button. You can then change the fragment size in 1MBFORT.INI and relaunch 1MBFort. However, to take full advantage of 1MBFort, you should exit and restart Windows so 1MBFort is loaded before any other program.

IDENTIFYING THE PROBLEM Some essential Windows structures must reside in low memory. When applications take up space in low memory they don't really need, this limited resource is used up. The result is an out-of-memory message when you still have plenty of memory above 1MB. 1MBFort prevents this from happening by fragmenting low memory so programs can't grab big chunks of it. When there are no sufficiently large block sizes below 1MB, Windows is forced to give the programs memory above 1MB (see Figure 3).

1MBFort eliminates out-of-memory messages by fragmenting low memory so programs aren't able to grab big chunks of it.

The memory problem that 1MBFort solves was encountered during the implementation of a large Windows client/server application written in Visual Basic. Some users reported they were frequently unable to start additional applications when only three or four Windows applications were running. When they attempted to load another application, Windows displayed the error message, "Insufficient memory to run this application. Quit one or more Windows applications and try again." Resource monitors indicated a large amount of free memory, and User/GDI system resources of more than 50 percent. The problem often could be relieved by changing the order in which tasks were launched, but this was an inconvenient solution.

At first I thought the Visual Basic application was somehow causing the problem. The application was complex, consisting of two executables, approximately 100 forms, and a couple hundred thousand lines of code. It also used a number of custom controls, DLLs, and host communication services. Microsoft Visual Basic technical support could not shed any light, so I took another approach: I started running the debug version of Windows to see if Windows itself could tell me what was wrong.

When the failure occurred, the debug output was "Kernel: GlobalAlloc(200) failed for ????". It was odd that resource monitors indicated I still had 10MB of free memory and yet GlobalAlloc() failed trying to obtain 512 bytes. Armed with this additional information, I decided to try Microsoft Technical Support again, but not for Visual Basic. This time I called Visual C++ support, and was sent an interesting and relevant Microsoft Knowledge Base article which described the same symptoms our users were encountering.

The article said the problem was a lack of available memory below 1MB for allocating the Task Data Base (TDB), which is necessary for starting new tasks. Windows uses GlobalDosAlloc() to try to allocate 512 bytes for the TDB, and GlobalDosAlloc() always allocates memory from the pool below 1MB. The solution suggested by the article was to use as little memory below 1MB as possible. If the call to GlobalDosAlloc() fails, Windows will display the error message described above. The Kernel debug binary will emit the message "GlobalAlloc(200) failed...", which is misleading because it was a call to GlobalDosAlloc() that failed.

So far so good, but I knew of no GlobalDosAlloc() calls in our VB application, so the search for an answer continued with Microsoft's memory analysis utility, HeapWalk. I used HeapWalk to sort by address and look for any blocks below A0000 (this is memory below 1MB). The search showed that a number of VBXs and DLLs used by the VB application were using substantial portions of memory below 1MB.

The reason for this was twofold. First, the DLL and VBX manufacturers chose

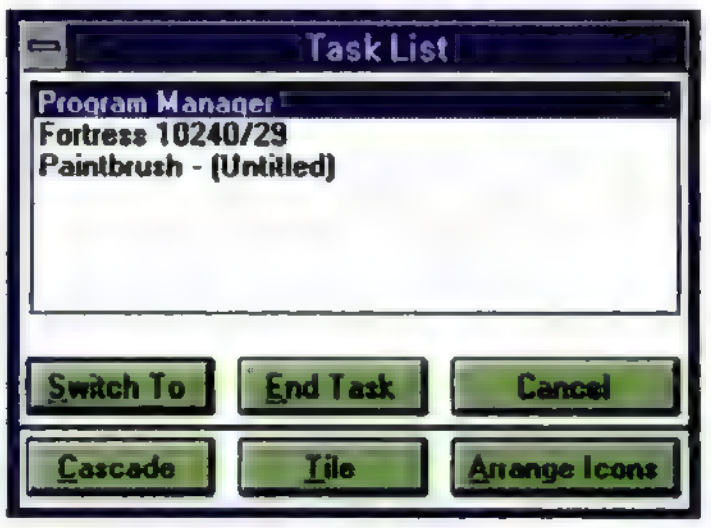

Figure 2: **You can tell 1MBFort is running by bringing up the Windows Task Manager. The size and number of fragments that 1MBFort creates is shown next to the program name.**

to mark certain segments as Fixed instead of Moveable. The second issue is how Windows allocates Fixed memory segments. The Windows Global Heap is a single pool consisting of memory below 1MB and memory above 1MB. When a program or DLL is loaded that contains a Fixed memory segment, Windows uses an allocation algorithm that employs a "bottom up, first fit" scheme. This will quickly

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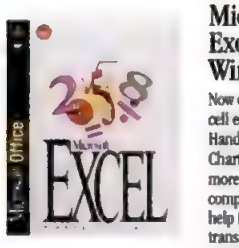

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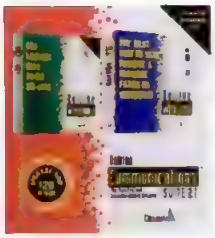

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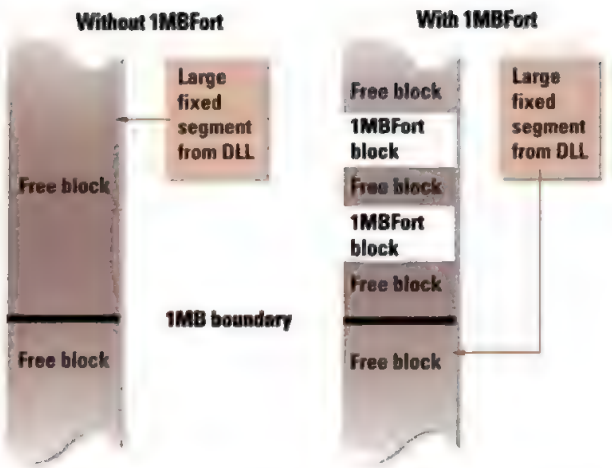

***Figure 3:* Without 1MBFort, large fixed segments can fit in low memory, using it up. When 1MBFort is loaded, these fixed segments are forced into memory above 1MB, thus leaving room for TDBs.**

consume memory below 1MB if you have many or large fixed segments in the EXEs, DLLs, or VBXs you are using. Fixed memory segments are needed in interrupt service routines and a few other cases, but some programs have segments set to Fixed that clearly do not need them to be.

I called Microsoft again, this time to see if there was any way to alter Windows' allocation scheme. I wanted a way to exclude memory below 1MB from Fixed segment allocation. First they suggested we wait for Windows 95 or upgrade to Windows NT, but neither approach was practical for us. Their next suggestion was to approach the DLL and VBX manufacturers to modify their Linker definition files so that segments are not marked as Fixed.

I approached one VBX manufacturer to see if they would entertain such a request. They informed me that their latest version of the VBX used a smaller fixed memory segment. So I downloaded the latest version and indeed HeapWalk showed that the VBX used 20K less memory below 1MB. Now I thought I was in good shape—20K meant I could get 40 additional programs started—but when I tried the load sequence again the problem still occurred. A trip back to HeapWalk showed that another DLL had slipped in and used the additional 20K. I began to think I was fighting a losing battle. Even if I could convince the manufacturers of all the DLLs and VBXs used by the VB program to decrease their fixed memory segments, who is to say an end user would not install other applications with large fixed segments, putting me back in the same predicament.

I decided to look for a programmatic solution to the problem. The main idea was to stop the DLLs and VBXs from obtaining low memory, and yet allow Windows to allocate lots of TDBs. All the program had to do was keep low memory fragmented into chunks small enough to block the DLLs and VBXs, but still allow enough memory for TDBs to be created. After working through a couple of possible designs, I implemented my choice in 1MBFort.

1MBFort allocates blocks of low memory, and then shrinks the allocated blocks to 32 bytes (the smallest possible size) to create memory fragments. Through testing, I discovered that block sizes smaller than 5,000 bytes caused intermittent GPFs. Block sizes larger than 20,000 often didn't solve the problem since they let

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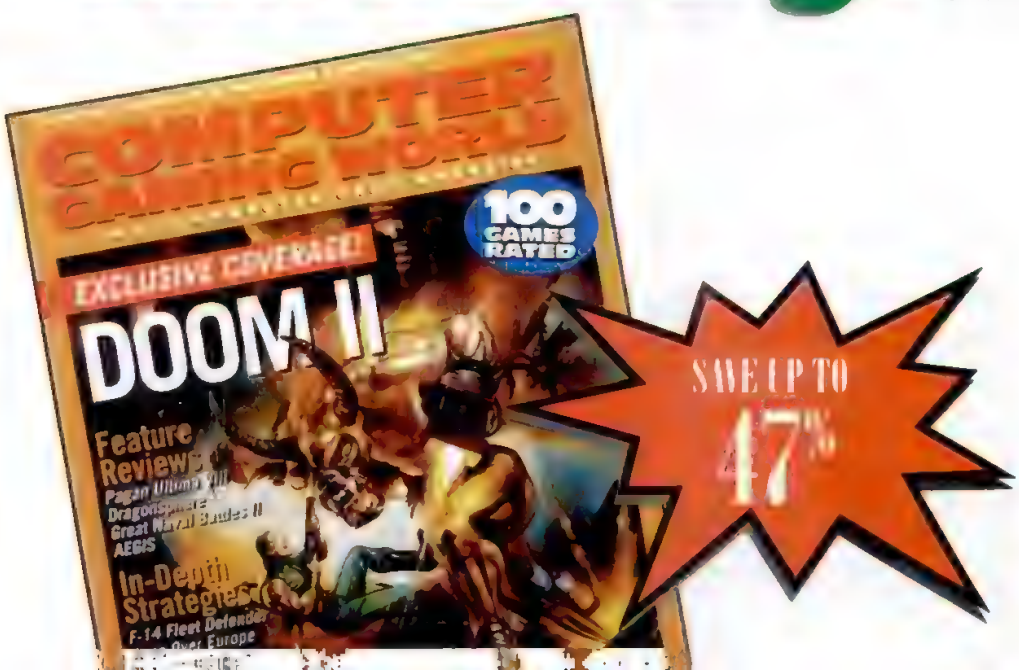

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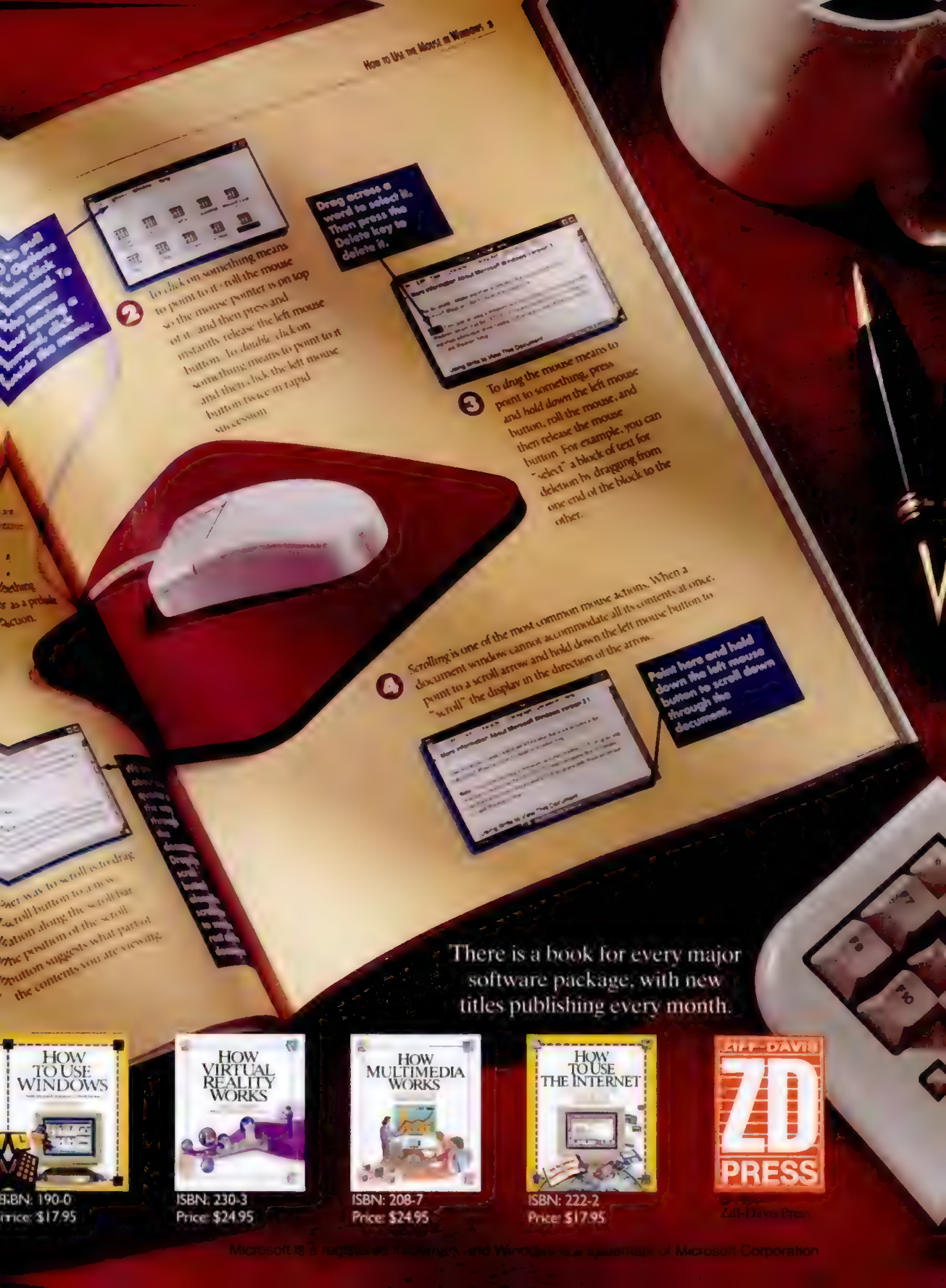
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fixed segments fit below 1MB. The optimum value may vary for each machine and operating sequence, but the default block size of 10,272 bytes generally works just fine.

The size and number of memory fragments is displayed in Task Manager next to the 1MBFort program name. For a rough indication of how much memory is available below 1MB, multiply the number of fragments by their size.

Sometimes low memory is used up by drivers. 1MBFort cannot prevent this. A quick way to check your video driver is to note the number of fragments reported in Task Manager, and then switch to the standard VGA driver and again note how many blocks 1MBFort reports in the Task Manager display. If there is a significant difference, then you may want to call the manufacturer of your video driver to see if an update is available. You can also use View1MB for this purpose.

1MBFort works with programs that are using low memory because they've marked segments as Fixed. If programs try to allocate low memory directly, Windows will return an error to the program. Whether the program will still run depends on how it handles this error message. If necessary, you can use View1MB to see the block size the program requires, and then adjust 1MBFort accordingly. A better solution is to load the program before 1MBFort so smaller fragments can still be used. However, almost no programs use GlobalDosAlloc() directly, so this situation is unlikely to arise.

Shrinking the blocks is what fragments low memory and prevents programs from hogging large portions of it.

INSIDE 1MBFORT The heart of 1MBFort is in the function HandleWMCreate(), which is called during the processing of WM_CREATE message (see Figure 4). First the program builds the INI filename by retrieving the user's Windows directory and appending "\1MBFORT.INI". It then passes the .INI filename to GetPrivateProfileInt() to obtain the block size. If there is no .INI file, 1MBFort uses the default block size of 10,272. Values below 5,000 are changed to 5,000; values above 20,000 are changed to 20,000.

1MBFort then allocates as many blocks as it can below 1MB by calling GlobalDOSAlloc(). The actual number of blocks created and the block handles are saved in the array hBlks[]. 1MBFort then attempts to shrink each block to 1 byte by calling GlobalRealloc(). Windows rounds this up to 32 bytes; 16 bytes is the smallest possible allocation, and there is 16 bytes of overhead. Shrinking the blocks is what fragments low memory and prevents programs from hogging large portions of it.

The last step is to set the caption of

```
/*************************************************************************

    FUNCTION: HandleWMCreate(HWND, UINT, WPARAM, LPARAM)

    PURPOSE:  Processes Create

    MESSAGES:

    COMMENTS: Here is the heart of 1MBFort.  We read the INI file and
              create fragmented blocks.

*************************************************************************/

void HandleWMCreate(hWnd, message, wParam, lParam)
HWND hWnd;                      /* window handle                */
UINT message;                   /* type of message              */
WPARAM wParam;                  /* additional information       */
LPARAM lParam;                  /* additional information       */
{

int i;
int totBlks;
DWORD hBlks[500];
DWORD hb;
unsigned int hbret;
unsigned int bsel;
unsigned int isize;
unsigned int nblocks;
unsigned int iret;
char sIniFile[255];

char appTitle[80];

/* Get users Windows Directory */
i=GetWindowsDirectory(sIniFile,254);

/* Add INI filename */
strcat(sIniFile,"\\FORTRESS.INI");

/* Get blocksize or default to -1 */
isize=GetPrivateProfileInt("FORTRESS","BLOCKSIZE",-1 ,sIniFile);

if (isize==-1) {

        /* No INI setting so create INI file with default value 10272
*/
        iret=WritePrivateProfileString("FORTRESS", "INSTRUCTIONS",
                "Valid BlockSize values 5000 to 20000 no commas.",
sIniFile);

        iret=WritePrivateProfileString("FORTRESS", "BLOCKSIZE",
                                        "10272", sIniFile);

        /* Use default blocksize */
        isize=10272;

}
else
{
        /* Range check user supplied block size */
        if (isize == 0) isize=10272;
        if (isize < 5000) isize=5000;
        if (isize > 20000) isize=20000;
}

/* Allocate as many memory blocks as possible */
          i=0;
hBlks[i]=GlobalDosAlloc(isize);
while (hBlks[i]!=0) {
        i++;
        hBlks[i]=GlobalDosAlloc(isize);
}

totBlks=i;

/* save number of blocks allocated for later display */
nblocks=totBlks;

/* display resulting size/blocks */
sprintf(appTitle,"Fortress %d/%d",isize - 32,nblocks);

/* set text for task manager display */
SetWindowText(hWnd, appTitle);

/* shrink blocks so that low order memory is fragmented */
for (i=0;i<=totBlks;i++) {
        hb=hBlks[i];
        memcpy(&bsel,&hb,2);
        if (bsel!=0) {
                /* reduce blocks to as small as possible */
                /* request 1 byte but will get 32 bytes due to
                /* overhead */
                hbret=GlobalReAlloc(bsel,1.0);
        }
}

}
```

***Figure 4:* 1MBFort fragments low memory by allocating large pieces and then shrinking them.**

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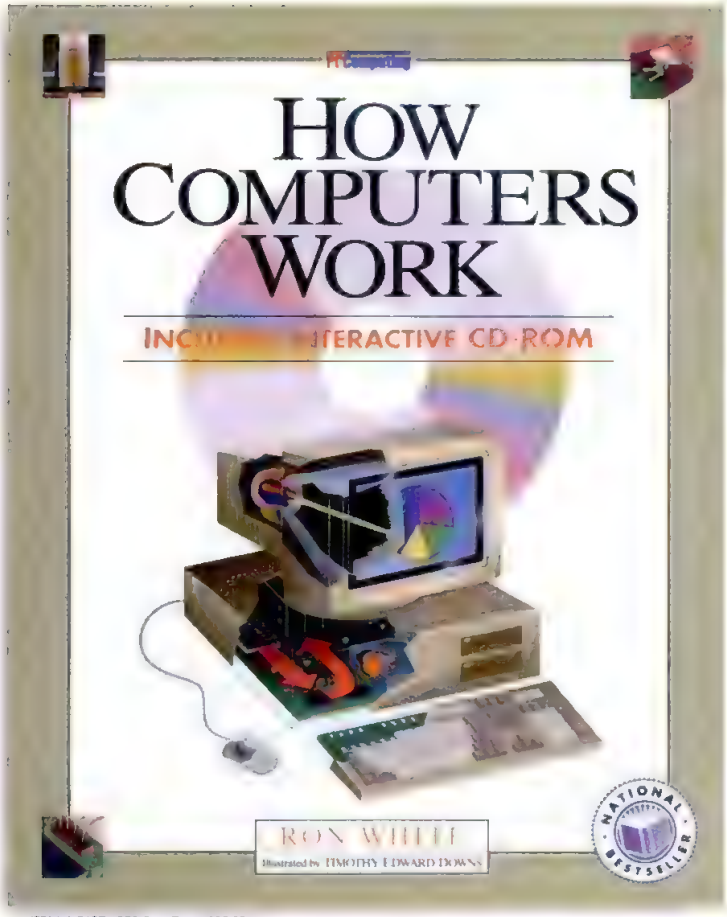

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the 1MBFort window so that Task Manager will display the number of blocks and their size. The low memory used by 1MBFort itself is minimal (the TDB, plus the number of blocks times 32 bytes), and the program does not significantly impact User or GDI system resources.

There are other conditions besides the one solved by 1MBFort that can result in out-of-memory error messages when you still have free memory. An out-of-memory message will also be generated when all of memory is fragmented into small chunks and there is no block large enough for Windows to load all segments marked in the program as Preload. This can be corrected by running a simple utility that calls GlobalCompact (-1), and then trying to load the program again. Or you may run into another annoying Windows limitation: the small size of the User and GDI heaps. There's no getting around this in Windows 3.1, but Windows NT and Windows 95 address this limitation. □

JOHN MCSORLEY IS A PROGRAMMER/ANALYST FOR THE INFORMATION TECHNOLOGY GROUP AT A MAJOR COMPUTER MANUFACTURER.

GUIDE TO OUR UTILITIES & HOW TO GET THEM

1MBFort

PURPOSE: Windows sometimes displays a warning message telling you that there isn't enough memory to run another program when you have plenty of memory. This is caused by a lack of low memory, memory below 1MB. 1MBFort solves this problem by preventing programs from using large blocks of it.

SETUP: To install 1MBFort, just copy 1MBFORT.EXE into a directory on your hard disk. 1MBFort then can be launched in one of two ways. You can use Program Manager to create an icon in your Windows Startup group, or add 1MBFORT.EXE to the Load = line of WIN.INI. The second method is preferable, since it ensures that 1MBFort is the first application started.

REMARKS: 1MBFort operates invisibly, but you can tell it is running by checking the Windows Task Manager list. Next to the 1MBFort program name in Task Manager is the number and size of the fragments created. By default, the fragment size is 10,240 bytes. This usually works fine, but you can change the fragment size if you have problems launching programs.

To change the fragment size, use Windows NotePad or another plain text editor to edit the file called 1MBFORT.INI in your Windows directory. The block size 1MBFort uses to create the fragments is set using this format:

```
[1MBFORT]
BlockSize = nnnnn
```

where *nnnnn* is in the range 5000 to 20000 and indicates the block size in bytes. If you enter a value below 5000, 1MBFort changes it to 5000. Likewise, values above 20000 are converted to 20000.

1MBFort can be terminated by selecting it within Task Manager and pressing the End Task button.

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THE FIRST TIME If you've never used ZiffNet, you'll need to find the access number nearest you. Set your communications software to 7 data bits, even parity, no stop bits, and full duplex. Then dial 800-346-3247 with your modem. When the modem connects, press Enter. At the HOST NAME prompt, enter PHONES. Follow the menus and note the closest access number. Or dial 800-635-6225 (voice) for instructions.

HOW TO JOIN ZIFFNET Dial the local access number. At the HOST NAME prompt, enter CIS. At the USER ID prompt, type 177000,5000. When you see the PASSWORD prompt, enter PC*MAGNET. Finally, when you see the ENTER AGREEMENT NUMBER prompt, enter PCMAG95. Current CompuServe members can type GO PCMAG at any CompuServe ! prompt. Once you enter your billing information, you'll see your personal user ID and temporary password.

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PC Solutions

TIPS AND TECHNIQUES TO INCREASE YOUR PRODUCTIVITY

HARDWARE

A Use for a CGA Monitor?

Q Is there any way I can display the output of a VCR on an old CGA monitor? I know that some CGA monitors have a built-in video input (I own one Magnavox that does), but I can't find any third-party devices that will supply this function to other CGAs at a reasonable cost.

Roger McAllister
Panorama City, California

▶PC MAGAZINE: It would be great if you could use an old CGA with a VCR, but unless the monitor has a composite video input (typically an RCA plug) on the back, chances are against your being able to come up with an affordable fix.

A monitor that accepts a video signal and a CGA monitor have a great deal in common. Indeed, one reason behind the CGA specification was to keep manufacturing costs down by keeping it close to television specifications. Both use a 15.7-KHz signal, and both have about the same resolution.

The problem is that the signals involved are still very different. A VCR puts out NTSC composite video, which is an *analog* signal: the image varies directly in proportion to continuous changes in the signal. A CGA monitor, on the other hand, uses *digital* signals, in which voltage changes for the red, green, and blue (and intensity) signals occur in discrete, on-or-off steps. As a result, a CGA monitor can display only a very limited color palette. CGA monitors also require separate horizontal and vertical sync signals.

It didn't cost much to add the extra circuitry to process composite video when CGA monitors were being built. The Apple II and many other microcomputers relied on composite video output, and so dual-mode monitors had a competitive advantage over the CGA-only models. That's a bygone era, however; today the best bet for your VCR is simply to buy a second TV set.—*Alfred Poor*

Powering Down

Q A number of people I know hook up their entire computer system (CPU, monitor, printer, and other peripherals) to a single power strip. After exiting their programs, they turn off the strip to shut everything down at once. This seems like turning off your TV and VCR by pulling a fuse in the basement. Is using a power strip switch a safe way to control all your equipment?

David Gowin
Toronto, Ontario, Canada

▶PC MAGAZINE: Not only is this completely safe for your equipment, but it can be a very good idea.

There was a time when personal computers were quite particular about the order in which components got power. Some early hard disks, for example, needed a few seconds to get up to speed before they were ready to start talking to the rest of the system. There are still a few peripherals—some scanners, for example—that want to be powered up before your computer. In general, however, all your components will get along just fine if they receive power at the same time. And there is no problem in powering them all down at once.

Using a good quality power strip can even improve matters by supplying surge suppression and a fuse or circuit breaker. This will give your components some protection against electrical damage. You will be certain that they all share a common ground, and you can be certain that they are all powered down, so you don't accidentally leave the printer running over a long weekend.—*Alfred Poor*

OPERATING ENVIRONMENTS

Solving Problems with WINCMD

Q Some Windows programs (like Solitaire) load with a display window that does not cover the entire screen. I can maximize the program to solve the problem while I'm in the application, but the next time I use the application I have to do it again. Is there a way to "save" the maximized setting?

Larry Blair
via ZiffNet

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PC DIRECT

PC DIRECT starts here with exciting offers from top direct vendors.

See index, page 306.

Elite Pentium™ Processor
The Power Is Building

The excitement is building...and so is MidWest Micro. In fact, we've been building for quite some time. Not just a line of Elite Computer Systems—but a reputation for quality and value. And now we'd like to invite you to watch. Welcome to one of our works in progress—Elite Pentium™ Processor Based Systems.

Zoned For 100 MHz.

When our developers first considered a Pentium project, they started by gathering the proper materials. And of course the raw power of Intel's Pentium processor was the very first item on everyone's list. In fact, this Elite line was designed to include four different levels of Pentium power—giving you P5-60, P5-75, P5-90 and P5-100 Systems to choose from. And in case the CD-ROM drives, fax modems and other extras built into these Elite PCs aren't enough to rattle your rafters, we've got plenty of add-ons in our product line for endless Pentium possibilities.

Based Systems...

Opening Doors Of Communication

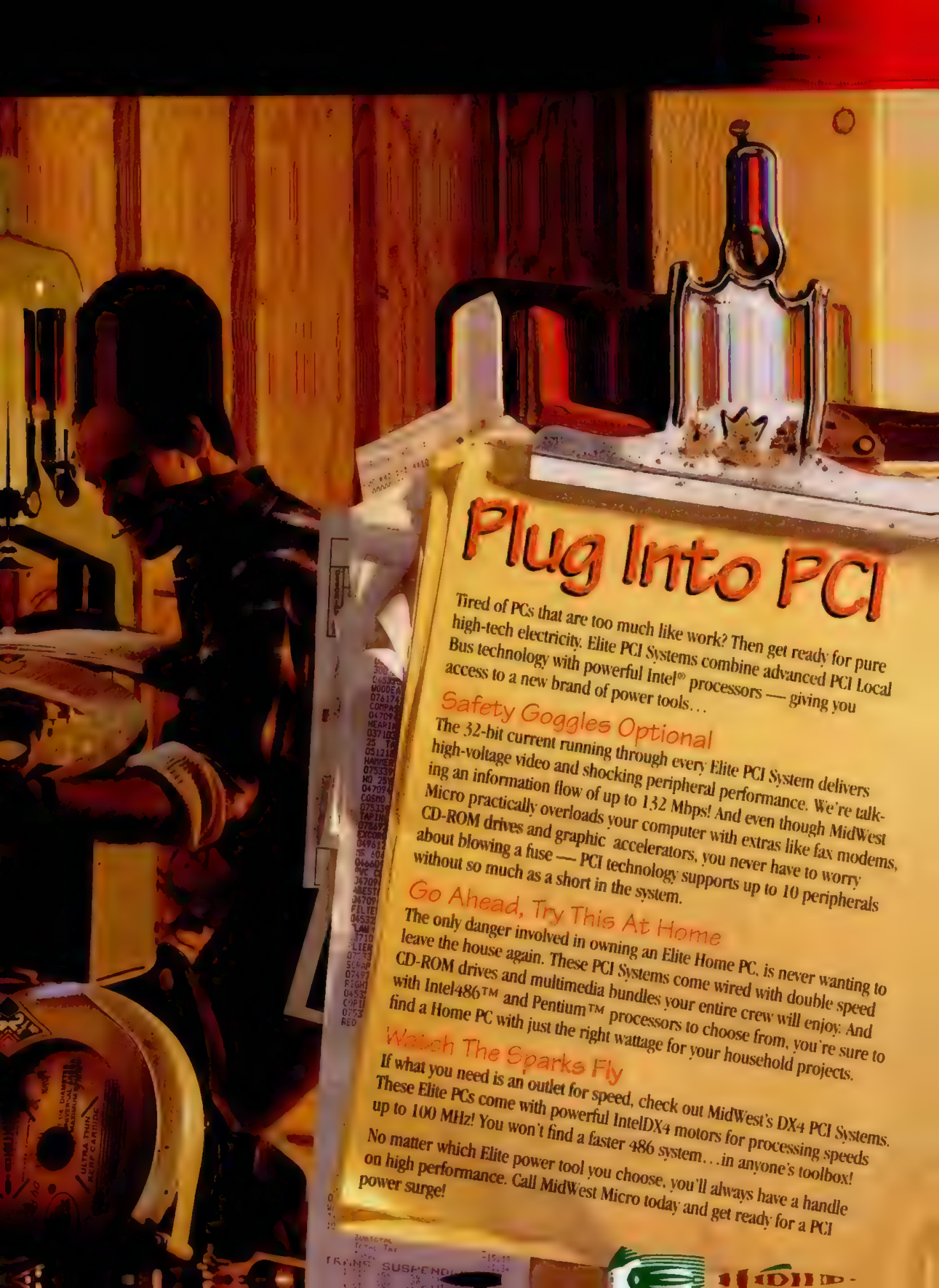
We've gotta hand it to those MidWest architects. With PCI framework built into every Pentium Processor Based Elite, you'll reach the maximum capacity in all your applications. That's because PCI Local Bus technology moves data across wide 32-bit beams—giving you quick access to your peripherals and hard drive. And when you combine PCI with the Intel Pentium chip, overall performance simply goes through the roof!

Hats Off To More Software

You don't need a hard hat to inspect *this* part of your Elite PC. Dwelling inside each Elite Pentium Processor Based System is a bundle of exciting multimedia software. And with Microsoft® titles like MS® Office Professional, Encarta™, Money, Bookshelf® '94 and Dangerous Creatures at your fingertips, you'll have no trouble finishing the daily projects *you* undertake.

Call your MidWest contractor today and we'll build an Elite Pentium Processor Based System just right for *your* lot.

Get out your measuring tape —here's something that might surprise you. Perfect for your home *or* workshop, the mini-tower case shown here is equipped with three 5.25" and five 3.5" drive bays—but it still maintains compact dimensions of 15" high by 6.5" wide. MidWest Micro believes in expanding your *options*...not the size of your computer.



Plug Into PCI

Tired of PCs that are too much like work? Then get ready for pure high-tech electricity. Elite PCI Systems combine advanced PCI Local Bus technology with powerful Intel® processors — giving you access to a new brand of power tools...

Safety Goggles Optional

The 32-bit current running through every Elite PCI System delivers high-voltage video and shocking peripheral performance. We're talking an information flow of up to 132 Mbps! And even though MidWest Micro practically overloads your computer with extras like fax modems, CD-ROM drives and graphic accelerators, you never have to worry about blowing a fuse — PCI technology supports up to 10 peripherals without so much as a short in the system.

Go Ahead, Try This At Home

The only danger involved in owning an Elite Home PC, is never wanting to leave the house again. These PCI Systems come wired with double speed CD-ROM drives and multimedia bundles your entire crew will enjoy. And with Intel486™ and Pentium™ processors to choose from, you're sure to find a Home PC with just the right wattage for your household projects.

Watch The Sparks Fly

If what you need is an outlet for speed, check out MidWest's DX4 PCI Systems. These Elite PCs come with powerful IntelDX4 motors for processing speeds up to 100 MHz! You won't find a faster 486 system...in anyone's toolbox!

No matter which Elite power tool you choose, you'll always have a handle on high performance. Call MidWest Micro today and get ready for a PCI power surge!

The Elite SoundBook —An Exciting Breakthrough In Portable Computing

Life is full of little surprises. One minute you're climbing the ladder of success — the next minute your world is crashing down all around you. So in order to be prepared for *your* next surprise, make sure there's always an Elite SoundBook in your toolbox. This powerful 486 notebook comes with business audio features, Advanced Power Management and your choice of screen, hard drive and processor up to DX4-100 — but it still manages to weigh in at less than seven pounds. Why did we make the Elite SoundBook so small? Because sometimes you need to get *into* a tight spot... to get *out* of one.

Features That'll Floor You

No matter how your new Elite SoundBook is configured, you'll always enjoy crystal clear audio and video. And that's definitely a must when you're working in unfamiliar surroundings. The SoundBook's special software, microphone and speaker let this amazing notebook talk you through even the toughest projects — just in case your hands are full. And since MidWest knows you've got *enough* headaches, each SoundBook comes with a crisp 9.5" monochrome, 10.3" dual-scan color or 9.5" active-matrix color display that's perfect for hours of comfortable viewing. Plus, you'll never have to worry about extension cord safety — the SoundBook's nickel metal hydride battery keeps working until the job's done!

Dig Your Phone Out Of The Wreckage And Give Us A Call

If you still think a computer system has to be a permanent fixture on your desktop, let the Elite SoundBook remodel your mind. And if you're *really* buried under your work, the Elite SoundBook Plus is available with a 75 MHz or 90 MHz Intel Pentium Processor! Calling MidWest Micro may have been the smartest decision Eugene ever made. Who knows, he might even have time to clean the attic before his wife comes home...

"The Elite SoundBook DX4-100 is the fastest notebook we have ever tested."

— *Mobile Office*, November 1994

Minutes ago, Eugene had no idea that his dining room ceiling couldn't support a 50 pound chandelier. He also had no idea how filthy his attic really was. Now he is painfully aware of both. He is also painfully aware that his wife is due home in less than one hour. Luckily, his SoundBook survived the mishap...
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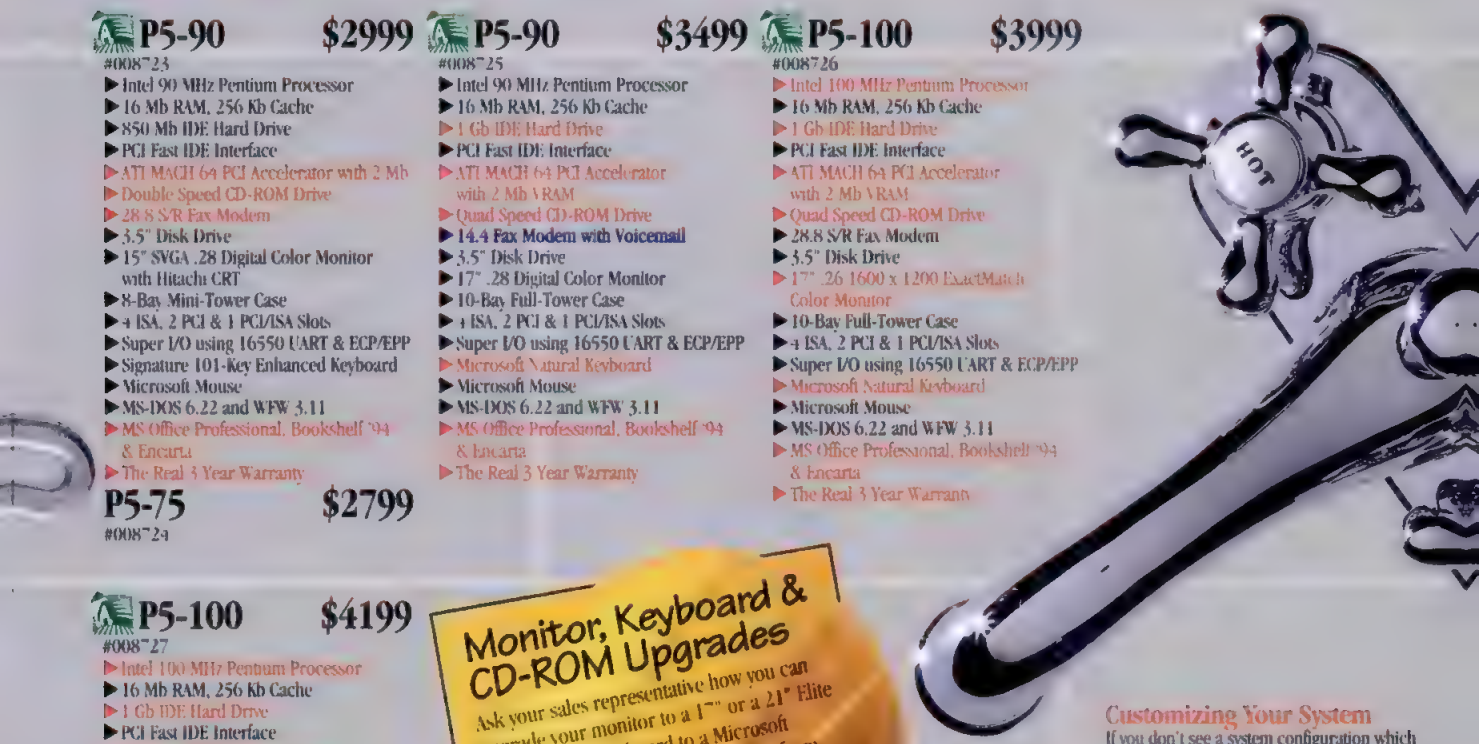

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- Altec Lansing Stereo Speakers
- 28.8 S/R Fax Modem
- 3.5" Disk Drive
- 17" .26 1600 x 1200 ExactMatch Color Monitor
- 10-Bay Full-Tower Case
- 4 ISA, 2 PCI & 1 PCI/ISA Slots
- Super I/O using 16550 UART & ECP/EPP
- Microsoft Natural Keyboard
- Microsoft Mouse
- MS-DOS 6.22 and WFW 3.11
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Monitor, Keyboard & CD-ROM Upgrades

Ask your sales representative how you can upgrade your monitor to a 17" or a 21" Elite Monitor, your keyboard to a Microsoft Natural keyboard and your CD-ROM from a double speed to a quad speed.

15" to 17"	$225
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17" to 17" ExactMatch	$85
17" to 21" ExactMatch	$709
Double Speed to a Quad Speed CD-ROM	$49
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If you don't see a system configuration which meets your needs, we'll be glad to customize a system for you. Choose your own case design, amount of RAM, hard drive size and other add-ons such as modems and multimedia kits.

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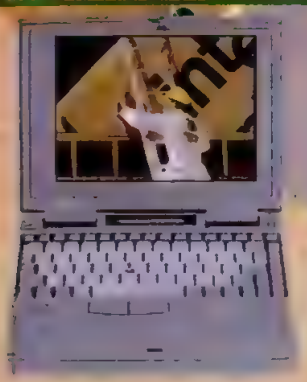

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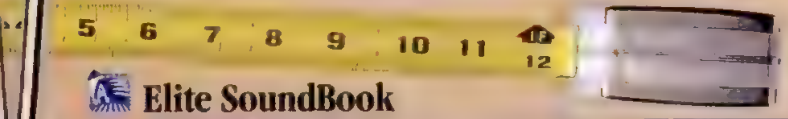

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AD#G03

CIRCLE 398 ON READER SERVICE CARD

❓ How can I control the placement of icons for applications that I run minimized from my start-up group? My desktop is arranged so that I can click on my primary applications easily. The bottom of my screen shows about 3/8 inch of wallpaper, and that's where the two minimized application icons appear. The problem is the icons aren't visible enough. I'd like to appear at the bottom, against the lower edge of the wallpaper. That would make it much easier to click on them. Thanks for any help you can provide.

Jim Mihalski
via ZiffNet

❓ When I boot Windows, I'd like to have the icons for the Logitech Trackball tracker, the SmartDrive Monitor, and the Windows clock always appear in the same spot. But the SmartDrive Monitor doesn't appear as an icon, and the Clock icon doesn't appear where I want it on the desktop. Only the Logitech Tracker icon positions itself automatically where I want it. Is there a way to get the others to appear as I'd like them to on booting?

John F. Pritchard
Gurnee, Illinois

Our Advisors

Douglas Boling is a contributing editor and the author of many utilities, including MBOOT.COM and EMS40.SYS.
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►**PC MAGAZINE:** Getting a program to run minimized is a simple matter of checking off the "Run Minimized" box in the Program Item Properties dialog. All three other problems can be solved by creating tiny scripts for the *PC Magazine* utility WINCMD. You can download WINCMD and its two add-on function libraries as WINCMD.EXE, WCLIB.WCL, and WCL2.WCL from PC MagNet's Utilities/Tips forum, library 2 (PC Magazine Utilities). To install the WINCMD files, simply copy them to your Windows directory and use File Manager to create an association between WINCMD.EXE and the extension .WCM.

Now if you want Solitaire always to come up maximized, create a text file called SOL.WCM containing the single line

```
LaunchSpecial LC_MAXIMIZE SOL.EXE
```

Add a program item for this file to the Program Manager group containing Solitaire. In the Program Item Properties dialog, click Change Icon. Enter SOL.EXE in the Filename field of the Change Icon dialog and click OK to select Solitaire's icon. Click OK again to close the Program Item Properties dialog. Once you've confirmed that activating this icon correctly brings up Solitaire maximized, you may want to delete the original Solitaire item from the group.

The problem of moving a program's icon toward the bottom edge of the screen is solved in a similar fashion, as follows:

```
LaunchSpecial LC_MINIMIZE SOL.EXE
SendKeys("%{ }M{down}^{down}{Enter}")
```

This time the LaunchSpecial command launches the application minimized. The script then uses the SendKeys command to move the icon down just the way you'd do it yourself using the keyboard. Within this command, ^{down} represents Ctrl-Down, which moves the icon one pixel, and {down} represents the unshifted down arrow, which moves the icon by a larger increment. Experiment to see how many of each keystroke are required to position the icon just where you want it, then customize the script to match. Install the .WCM file to replace the application in your Startup group as described for the

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```
IF IsRunning(SOL.EXE)
  Exit
LaunchSpecial LC_MINIMIZE SOL.EXE
' Choose Move from system menu
Sendkeys("%{ }M")
N = 1
WHILE N < 80
  DO
    Sendkeys("{right}{up}")
    N = N + 1
    Delay(1)
  END
' Move out of extreme top right, open program
SendKeys("{left}{down}{enter}{enter}")
Exit
```

Figure 1: **In order to place a program's icon relative to the top right corner of the screen, this WINCMD script must first shove the icon all the way into that corner.**

previous example.

Setting up a program so that its icon is always in a specific location is a bit more difficult. The problem is that WINCMD doesn't include commands for placing icons or for getting an icon's position. The script has to force the icon into a known position and then move it from there. Figure 1 shows an example script that puts Solitaire's icon in the top-right corner of a 1,024-by-768 screen. The script forces the icon into the extreme top-right corner by repeating the keystrokes {up} and {right} 80 times. (Screen resolutions smaller than 1,024-by-768 will require fewer than 80 repetitions—experiment!) Then it moves the icon out of the corner so the whole icon is visible, sends {Enter} to end the movement, and sends {Enter} again to open the program. When you minimize the program, its icon will be in the top-right corner.

The Delay(1) command is necessary because Windows needs a finite amount of time to process the keyboard movement commands. Omit the delay and you'll find the icon doesn't complete its trek into the top-right corner. Also, you'll need the very latest WINCMD, Version 1.4, to run this script, because of a quirk in the Delay() command in earlier versions. (The sample script is available on PC MagNet as SOLTR-.WCM).—*Neil J. Rubenking*

Counting with a Batch File

❓ I'm looking for a way to run MS-DOS's DEFRAG utility every twenty bootups or so. I know how to run DEFRAG from the command line, but that solves only half the problem. How can I execute this program every 20 start-ups?

Michael Wrighton
Wilmington, Delaware

▶**PC MAGAZINE:** Batch files aren't good at counting with numbers, but they're great at comparing strings. The batch file DCOUNT.BAT (Figure 2) builds a string of exclamation marks in an environment variable, adding one mark each time you call the batch file. DCOUNT builds a second, temporary batch file (DCOUNT2-.BAT), which in turn creates the string. Every line in DCOUNT2.BAT adds an exclamation mark to the initially empty environment variable DCount. When the string builds up to 20 exclamation marks, DCOUNT.BAT executes DEFRAG and

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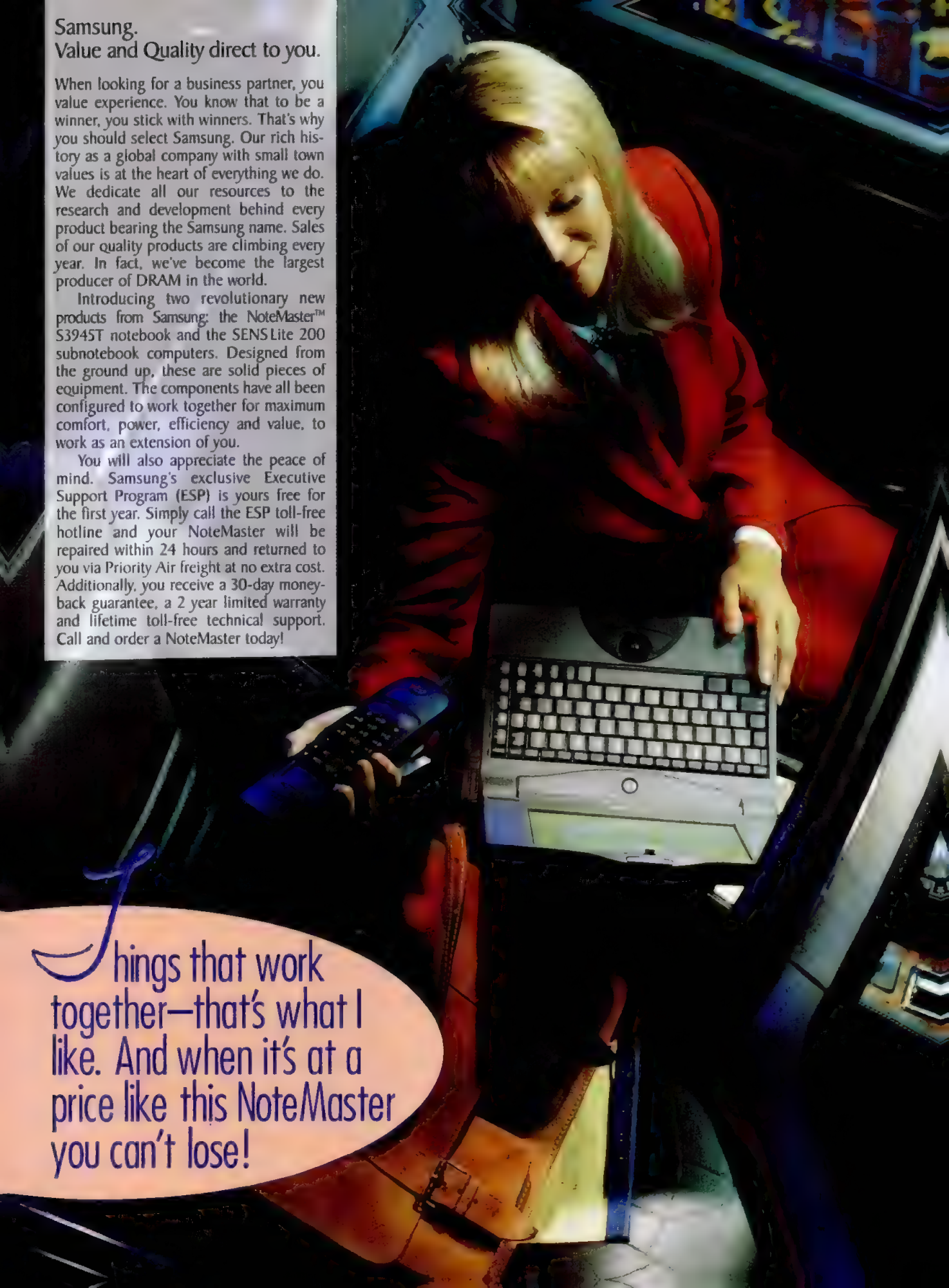

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```
@ECHO OFF
REM NO space after "!" in next line!
ECHO SET DCount=%%DCount%%!>> C:\BAT\DCOUNT2.BAT
SET DCount=
CALL C:\BAT\DCOUNT2.BAT
REM Delete next two lines for "quiet" operation
ECHO    DCount="%DCount%"
ECHO DEFRAG at "!!!!!!!!!!!!!!!!!!!!"
IF NOT '%DCount%'=='!!!!!!!!!!!!!!!!!!!!' GOTO NotYet
DEL C:\BAT\DCOUNT2.BAT
ECHO Twentieth time - defragging
DEFRAG C: /F
:NotYet
SET DCount=
```

***Figure 2:* DCOUNT.BAT keeps track of how many times it has executed and runs DEFRAG every twentieth time.**

deletes DCOUNT2.BAT, ready for the next cycle.

To use DCOUNT.BAT, put it in the directory you use for batch files. If necessary, change all occurrences of C:\BAT to the name of your batch file directory. In your AUTOEXEC.BAT, add a line that CALLs DCOUNT.BAT. That's it! Now every twentieth time AUTOEXEC executes, it will run DEFRAG.

—Neil J. Rubenking

Copying Huge Files to Floppy Disks

Today's programs often include individual files that are as large as 20MB or more. Is there any way to spread a huge file over multiple floppy disks and then restore the pieces as a single file on a second computer? Even using PKZIP, a 20MB file is still too big to fit on one floppy disk.

Kalvin Shen
New York, New York

►PC MAGAZINE: Updating to the latest PKZIP (Version 2.04G) will solve your problem. The new disk-spanning feature, invoked with the -& command-line switch, tells PKZIP to use as many floppy disks as necessary to hold the compressed files. When one disk fills up, PKZIP simply prompts for another. You can optionally tell PKZIP to quick-format the disks before use, so you don't have to prepare a stack of formatted disks in advance. The command PKZIP /h2 will display detailed syntax information for the -& switch.

If you're just moving one huge file, PC Magazine's SLICE utility can help. SLICE copies a file to as many floppy disks as necessary. On the first disk of the set, SLICE creates SPLICE.COM, a program that re-assembles the file on the destination machine. You can download SLICE.ZIP from PC MagNet's Utilities/Tips forum, Library 2 (PC Magazine Utilities).*—Neil J. Rubenking*

WORD PROCESSING

Hidden Formatting Info in Winword 6.0

When you look at a document in Microsoft Word for Windows 6.0 in normal view with Show All turned on, some heading paragraphs have little square boxes in the left margin of the selection bar, next to the first line of the paragraph. You can't select them, and they don't seem to do anything, but they must be there for some reason. Do they mean anything? I can't find any hint in the manuals.

Matthew Davidson
Fort Lee, New Jersey

►PC MAGAZINE: I've also wondered about these little square boxes. But, as Mr. Davidson points out, they don't seem to be documented anywhere, so I simply ignored them until this letter motivated me to take a closer look. A little experimentation proved that they do indeed mean something.

To see the boxes, first you have to set Word to show paragraph marks. My preference is to show the paragraph marks only, so I choose Tools|Options, then View, and make sure there's a check in the Paragraph Marks check box. You can check the All box instead, however, or click on the Show/Hide button on the standard toolbar to show all nonprinting characters.

With the paragraph marks visible, the boxes will appear for any paragraph that is formatted with Keep Lines Together, Keep with Next, Page Break Before, or Suppress Line Numbers, as shown in Figure 3. The boxes, in short, indicate any text-flow formatting other than Widow/Orphan control and Don't Hyphenate. They show up with many of Word's default heading formats because those headings are formatted as Keep with Next. And now that you know what they mean, you can use the boxes as a quick way to spot paragraphs that have special text-flow-formatting instructions.

—M. David Stone

Nothing checked on the Text Flow tabbed card for this paragraph¶
Widow and orphan control checked in this paragraph. ¶
▪ Keep lines together checked in this paragraph. Keep lines together ch
paragraph.¶
▪ Keep with next checked in this paragraph. Keep with next checked in
paragraph.¶
▪ Page Break Before checked in this paragraph. Page Break Before che
paragraph.¶
▪ Suppress Line Numbers checked in this paragraph. Suppress Line Nu
checked in this paragraph. ¶
Don't Hyphenate checked in this paragraph.¶

***Figure 3:* The squares to the left of some of these paragraphs indicate text-flow formatting.**

SPREADSHEETS

Backing Up Excel Files on Floppy Disks

I have several Microsoft Excel files that I update twice a week. Because of the extreme sensitivity of my data, I am not allowed to store the files on the LAN or even on my local hard disk. To maintain a "primary" file and a backup, I use two floppy disks. After updating the primary, I remove the primary disk from the drive, insert backup disk and then save my file a second time.

All this works fine—or, at least it did work fine until I switched to Excel, Version 5.0. In Excel 5.0, after I update the primary disk and replace that disk with the backup, I can no longer save to the floppy disk drive. I get a "cannot access A: drive" error when I try to use Save or Save As on the second floppy after writing to the first floppy.

Fortunately, I can still save to both floppies using the Excel

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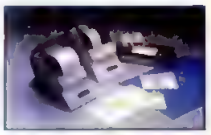

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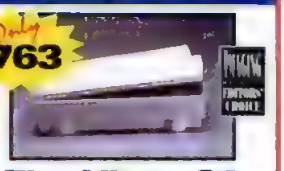

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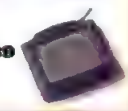

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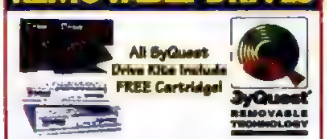

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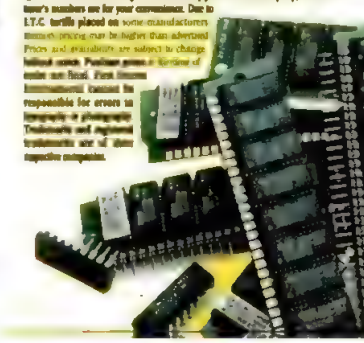

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CIRCLE 014 ON READER SERVICE CARD

4.0 format—but what a step backwards for Microsoft to have taken! Is there any way I can change all my files to Version 5.0 and still be able to save them to more than one floppy disk?

Walter G. Miller
Rome, New York

►PC MAGAZINE: According to Microsoft, this behavior is a quirk of Windows 3.*x* and will be gone in Windows 95. Microsoft says it also affects applications other than Excel, although you may see different error messages in other programs. I was able to confirm this easily with Microsoft Word for Windows 6.0.

Diskette saves that do not call Share or Vshare, such as the conversion of an Excel 5.0 to the Excel 4.0 format, avoid the problem. You can also avoid the problem by using diskettes that don't have serial numbers. But to format diskettes without serial numbers, you would have to use a computer that's running a version of DOS prior to DOS 4.0.

If you must avoid putting files on a hard disk, I would suggest saving to only one diskette while you're in Excel. At the end of an Excel session, double-click the DOS Prompt icon in Program Manager. At the C: prompt, type:

```
COPY A:\FILENAME.XLS B:
```

where FILENAME is the name of the file you saved from Excel. Use this syntax even

If you're working with text columns in your tables, you should be spell-checking them.

if you have only one floppy disk drive. After reading from your primary diskette, DOS will prompt you to "insert a diskette for drive B." Remove your primary diskette, insert your backup diskette into the same drive, and press Enter. DOS will copy the data it read to your backup diskette. Depending on the size of your file, you may need to repeat this shuffle a few times before the file is entirely copied. But if you want to use the Excel 5.0 file format, with its multipage documents, this is probably the best way to go.—*Craig Stinson*

DATABASES

Spell-Checking for Microsoft Access

The vast majority of the databases in existence today contain at least some textual data. And dollars to donuts that many of those databases contain spelling errors. While spell-checking word processing documents has long been routine, spell-checking database content is, dare I say, unusual. So let's take a moment right now to agree how things ought to be. If you're working with text columns in your tables—you know, columns like Title or Description or for that matter, Memo fields for storing things like notes on telephone conversations—you *should* be spell-checking the content. Human potential for error does not decrease when you move from typing text into a word processor to entering textual data into a database. (Trust me.) And we all want our database output to be as polished and professional as our favorite word processed correspondence.

Spell-checking should be a standard feature in database software. Until that happens, users of Microsoft Access should consider the Total Access Speller (TAS), an add-on product from FMS. The Total Access Speller attaches itself to your File or Add-Ins menu (or the Help menu for users of Access, Versions 1.1 or 1.0), and can be called up at any time to spell-check the text in your tables.

The product works differently depending on the type of window you have frontmost when you call it up. If you don't have a form active, or if you have a database container window frontmost, the Spell Wizard is started. The Spell Wizard takes you step by step through selecting the tables or queries and the columns to check. Note that the source of the data can be either a table or a query. If it's a query you can spell-check the result as long as it's updateable. (You'll be stopped otherwise.)

If a form is active when you start up the Spell Checker, the field with the focus is spell-checked, and only for the current record.

The Spell Check Dialog (see Figure 4) works much as your favorite word processor's spell-checker does, flagging words that aren't found in the product's 120,000-word dictionary and letting you select from a list of suggested alternatives. For corrective action, you can add flagged words to your own custom dictionary, or you can change or ignore the word five different ways, three of which are database-intelligent.

The first choice is to change or ignore the current error only. Second, you can change or ignore all occurrences throughout the current session. Third, you can change or ignore all occurences in the current field on the current record only. Fourth, you can change or ignore all occurrences in every field of the current record. And last, you can change or ignore all occurrences in the current column throughout the entire table. Because the product uses Access's Jet database engine to update records, your data integrity rules and constraints are enforced automatically. A programmatic interface is available that lets you call the spell-checker directly from Access Basic code.

The single-user version costs $69. Multiuser versions and an unlimited runtime version for vertical-market application developers are available. For more information call FMS in Vienna, Virginia, at 703-356-4700.—*Sal Ricciardi*

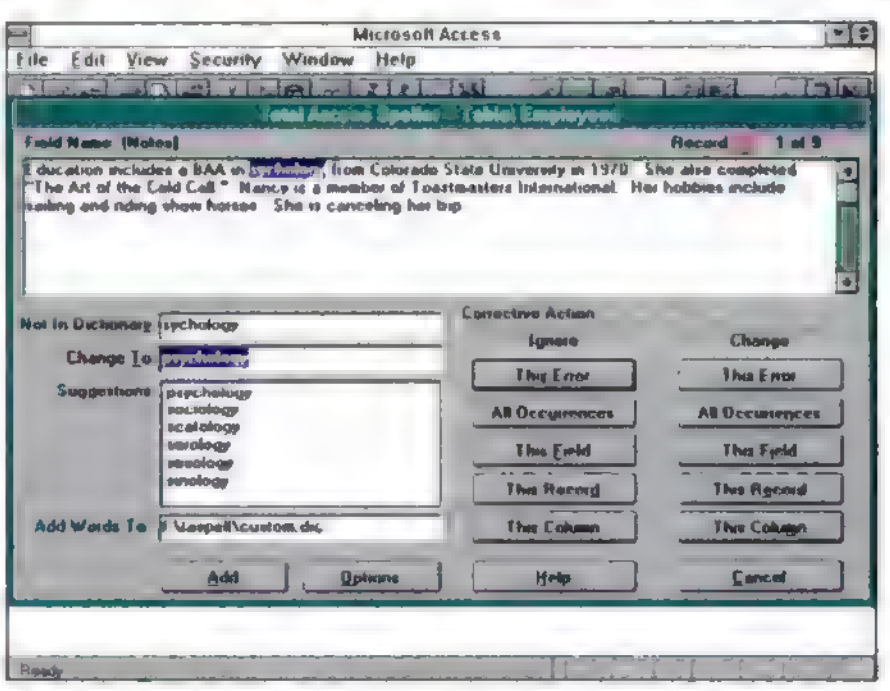

Figure 4: **The Total Access Speller can spell-check the text in your Access databases. Note the special buttons for changing or ignoring word occurrences at the field, record, or column level.**

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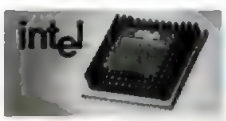

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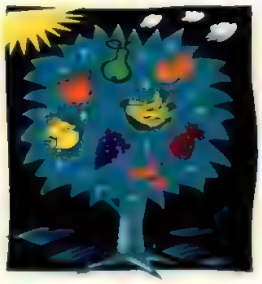

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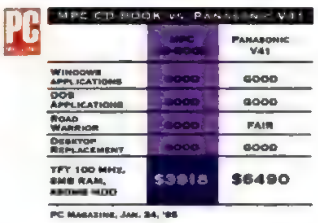

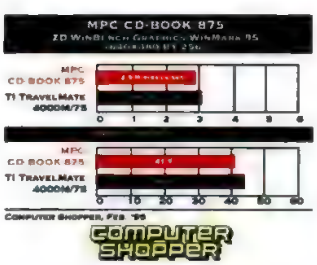

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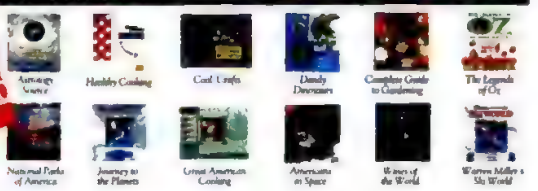

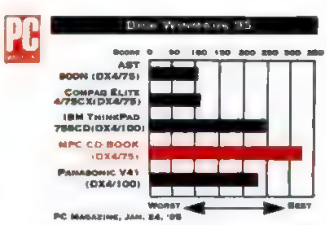

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- DX2/66MHz processor
- 340MB hard drive

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- Big 9 1/2" TFT active-matrix color screen
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Z-NOTEFLEX Multimedia Notebook

Modular architecture for a multitude of user-upgradable features.

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- ▲ 32-bit VESA local bus video
- ▲ Detachable video display
- ▲ Built-in 16-bit stereo sound with speaker, and microphone
- ▲ Integrated trackball
- ▲ 2 Type II or 1 Type III PCMCIA slot
- ▲ MS-DOS, Windows for Workgroups, Indeo Video
- ▲ 3-Year Warranty

Processor	RAM	Screen	Hard Drive	Price
486DX2/50	4MB	10.3" Dual Scan	200MB	$2759
486DX2/50	4MB	10.3" Dual Scan	340MB	2969
486DX2/50	4MB	9.5" Active	340MB	4099
486DX2/50	8MB	9.5" Active	450MB	4419
486DX4/75	8MB	9.5" Active	520MB	4989
486DX4/100	4MB	10.3" Dual Scan	700MB	4099

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High-end features at a low-end price!

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- ▲ Modular design with removable hard drive & floppy drive
- ▲ 32-bit VESA local bus graphics, 1MB video RAM
- ▲ 2 Type II or 1 Type III PCMCIA slot
- ▲ Audio module slot
- ▲ Built-in AC adapter
- ▲ MS DOS, Windows 3.1 and CoSession Host software
- ▲ 1-Year Z-CARE on-site service

Processor	RAM	Screen	Hard Drive	Price
486DX2/50	4MB	9.5" Mono	200MB	$1699
486DX2/50	4MB	9.5" Dual Scan	200MB	2129
486DX2/50	8MB	9.5" Dual Scan	340MB	2459
486DX2/50	4MB	9.5" Active	340MB	3069

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- ▲ PCMCIA Type II interface included
- ▲ Upgrade any notebook with PCMCIA to a full multimedia machine in one easy step
- ▲ *Desktop interface now available for $59.99*

$499.99

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HP OmniBook Notebook PCs 4000 Series

Processor	Screen	Hard Drive	Price
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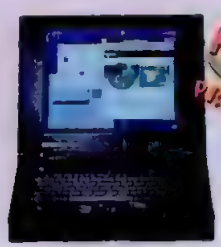
486DX2/50	10.3" Dual Scan	340MB	3349
486DX2/50	10.3" Dual Scan	520MB	3729
486DX2/50	10.4" Active	340MB	4459
486DX2/50	10.4" Active	520MB	4839
486DX4/100	10.3" Dual Scan	340MB	4069
486DX4/100	10.3" Dual Scan	520MB	4449
486DX4/100	10.4" Active	340MB	5179
486DX4/100	10.4" Active	520MB	5559

HP OmniBook Notebook PCs 600 Series

Processor	Screen	Hard Drive	Price
486DX2/50	8.5" Dual Scan	170MB	$2549
486DX2/50	8.5" Dual Scan	260MB	2829
486DX4/75	8.5 Dual Scan	170 MB	3099
486DX4/75	8.5" Dual Scan	260MB	3379



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HP OmniBook Notebook PC

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HP DeskJet 320 w/Sheet Feeder	359.99
HP DeskJet 540	289.99
HP DeskJet 560C	479.99
HP DeskJet 1200C	999.99
HP DeskWriter 320	299.99
HP DeskWriter 320 w/Sheet Feeder	359.99
HP DeskWriter 540	289.99
HP DeskWriter 560C	479.99
HP DeskWriter 1200C/PS	1589.99

HP DeskJet 320 Printer shown with optional sheet feeder and colorkit

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- 8MB RAM expandable to 40MB
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- 2 PCMCIA slots (Type II, Type III)
- Accupoint integrated pointing device
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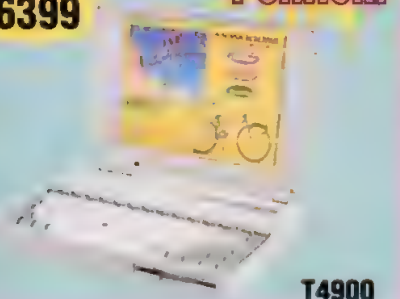
75MHz Pentium

$6399



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- 82-key keyboard
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- Ballpoint mouse with Quickport (T1900s)
- Accupoint pointing device (T2400s)
- Enhanced power management

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	T1910	486SX/33	9.5" Dual Scan	200MB	1779
	T1960	486DX2/50	9.5" Dual Scan	200MB	2159
	T1960	486DX2/50	9.5" Dual Scan	320MB	2329
	T1960	486DX2/50	8.4" Active	200MB	2629
	T1960	486DX2/50	8.4" Active	320MB	2799
Pro Series	T2400	486DX2/50	9.5" Dual Scan	250MB	2469
Pro Series	T2400	486DX2/50	9.5" Dual Scan	320MB	2629
Pro Series	T2400	486DX2/50	8.4" Active	250MB	2959
Pro Series	T2400	486DX2/50	8.4" Active	320MB	3219
Pro Series	T2450CT	486DX4/75	9.5" Active	320MB	4239
Pro Series	T2450CT	486DX4/75	9.5" Active	500MB	4529

Business Lease: $50/mo.

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Satellite Notebook

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- Ultra-portability at only 4.4 lbs.
- 8MB RAM expandable to 24MB
- PCMCIA Type II slot
- External 3.5" diskette drive
- Integrated AccuPoint pointing device

Processor	Screen	Hard Drive	Price
486DX2/50	8.4" Active	250MB	$3469

Business Lease: $114/mo.

$3469

T4700, T4800 and T4850

- Brilliant color display with local bus video
- 2 PCMCIA slots (Type II, Type III)
- Microsoft Sound System, built-in microphone, audio out port
- MS-DOS, UltraFont, Indeo video compression software, Windows for Workgroups 3.11 and Run Time for Windows

as low as $3129

Model	Processor	Screen	Hard Drive	Price
T4700	486DX2/50	9.5" Active	320MB	$3129*
T4800	486DX4/75	9.5" Active	500MB	4239
T4850	486DX4/75	10.4" Active	500MB	4579
T4850	486DX4/75	10.4" Active	772MB	4879

Business Lease: $112/mo.

T4800

Ether Modem 10BaseT & 14.4/14.4

$449.99

Modem	Description	Price
XJ1144	14.4/14.4 XJACK	$179.99
CC3144	14.4/14.4 PCMCIA	$179.99
XJ2144	14.4/14.4 XJACK GOLD	$209.99
CC4144	14.4/14.4 PCMCIA GOLD	$209.99

Megahertz

Magnavox

14" Monochrome 640x480	$119.99
14" 1024x768ni, 28	249.99
14" 1024x768ni, 28	279.99
15" 1024x768ni, 28	329.99
15" 1280x1024ni, 28	399.99
17" 1024x768ni, 31	659.99
17" 1280x1024ni, 28	699.99
20" 1280x1024ni, 31	1099.99

Novell

Personal Netware, 1 User	$64.99
Personal Netware, 5 User	269.99
NetWare, V3.12, 5 User	599.99
NetWare, V3.12, 10 User	1349.99
NetWare, V3.12, 25 User	1999.99
NetWare V4.1, 25 User	2499.99
NetWare V4.1, 50 User	3299.00

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Kingston Memory Upgrades

System	4MB	8MB
Toshiba 1960, 4700, 4800	$249.99	$489.99
Toshiba T3600	224.99	439.99
NEC Versa V	269.99	479.99
NEC Versa S	199.99	379.99
COMPAQ Contura 400C	249.99	479.99

Smart Modular

SMART ST1414L 14.4/14.4 fax modem with Voice Mail!

$149.99

Maxtor Hard Drives

420MB IDE Drive, Enhanced Kit	$219.99
540MB IDE Drive, Enhanced Kit	239.99
850MB IDE Drive, Enhanced Kit	339.99
171MB PCMCIA Drive, Type III	389.99

MobileMax 131

$339.99

Motorola

PCMCIA 14.4 cellular modems

$239.99 PCMCIA

Actual product differs slightly from photo

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AST Advantage!
Adventure Multimedia

- ▲ Quad speed IDE CD-ROM drive
- ▲ 16-bit Creative Labs SoundBlaster
- ▲ 14.4 Send/Receive Fax modem **with telephone answering and speaker phone**
- ▲ LOADS of FREE Software (titles included differ by model)
- ▲ 3-Year Warranty

Model	RAM	Hard Drive
486DX2/66	8MB	540MB
486DX2/66	4MB	540MB
486DX2/66	8MB	540MB
Pentium 75MHz	8MB	540MB
Pentium 75MHz	8MB	1GB
Pentium 90MHz	8MB	1GB
Pentium 100Mhz	8MB	1GB

CALL for latest pricing

Business Lease $58/mo.
**AST Color Monitors start at $349.99*

Adventure Multimedia

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Ascentia 910N

- ▲ 10.4" Active and 10.3" Dual Scan displays
- ▲ ***NEW!*** Lithium Ion Battery for extra long life
- ▲ Travel weight less than 7 lbs.
- ▲ Hard disk storage up to 700MB

Processor	Screen	Hard Drive	Price
486DX2/50	10.3" Dual Scan	340MB	$2949
486DX4/75	10.3" Dual Scan	510MB	3439
486DX4/75	10.4" Active	510MB	4719
486DX4/75	10.4" Active	700MB	4999

Ascentia 910N

Ascentia 810N

- ▲ LARGE, 10.4" Dual Scan displays
- ▲ 4MB RAM expandable to 20MB
- ▲ Removable hard drive and floppy drive
- ▲ 2 Type II or 1 Type III PCMCIA slot

Model	Screen	Hard Drive	Price
486DX2/66	10.4 Dual Scan	250MB	$ 2399
486DX2/66	10.4 Dual Scan	340MB	2539
486DX2/66	10.4 Dual Scan	510MB	2689

Business Lease: $88/mo.

Packard Bell

The Multimedia Standard

Packard Bell
Force Multimedia

- ▲ 16-bit SoundBlaster compatible sound card
- ▲ Built-in 14.4 Send/Receive Fax modem
- ▲ LOADS of ***FREE*** Software preinstalled, some titles include: DOS, Windows, Grolier Multimedia Encyclopedia, U.S. Atlas, World Atlas, MS Works, MS Money, MegaRace, 3-D Dinosaur Adventure, Prodigy, Space Adventure, Kids Zoo ***PLUS MORE***
- ▲ PCI Local bus for fast, fast graphics
- ▲ 256KB Cache standard
- ▲ PCI local bus hard drive
- ▲ Up to 1280 x 1024 video resolution

Multimedia Desktop

Model	RAM	Hard Drive	Price
Pentium 60MHz	8MB	420MB	$1799
Pentium 90MHz	8MB	810MB	2599
Pentium 100MHz	8MB	1GB	2949

Packard Bell Monitors start at $229.99
Business Lease: $66/mo.

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Premium Performance and Rock Solid Support

ThinkPad® 510 Subnotebook

- ▲ IBM 486BL2/50 processor
- ▲ 4MB RAM exp. to 20MB
- ▲ 200MB hard drive
- ▲ 7.7" color display
- ▲ Type II PCMCIA slot
- ▲ TrackPoint II integrated pointing device
- ▲ 3.5" external floppy drive
- ▲ Weighs only 4.0 lbs.
- ▲ IBM DOS 6.3, Windows 3.1, Lotus cc:Mail, Organizer, ScreenCam, Official Airline Guide FlightDisk, CoSessions Host, Prodigy, America Online, and FaxWorks 3.0

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ThinkPad® 360 and 360E Notebooks

- ▲ 4MB RAM exp. to 20MB
- ▲ Modular design, removable hard drive & floppy drive
- ▲ 2 Type II or 1 Type III PCMCIA slot
- ▲ TrackPoint II pointing device
- ▲ IBM DOS 6.3, Windows 3.1 and 8 **FREE** software titles
- ▲ Port Replicator and Docking Station available

Processor	Screen	Hard Drive
486SL/33	8.4" Active	340MB
486DX2/50	9.5" Dual Scan	340MB
486DX2/50	9.5" Dual Scan	540MB
486DX2/50	8.4" Active	340MB
486DX2/50	8.4" Active	540MB

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NOW AVAILABLE!

ThinkPad® 755CE, CSE and ThinkPad® 755CD

- ▲ 486DX4/100 processor w/16KB cache
- ▲ 8MB RAM expandable to 40MB
- ▲ 340MB, 540MB or 810MB removable hard drive
- ▲ **Huge 10.4" brilliant screen (active or dual scan)**
- ▲ Built-in sound, speaker, microphone
- ▲ Built-in 14.4 data/fax modem
- ▲ Infrared ports for wireless data transfer
- ▲ **Built in telephone answering machine & speaker phone**
- ▲ 2 Type II or 1 Type III PCMCIA slot
- ▲ Over 15 popular software titles included!

The Multimedia ThinkPad755CD also includes: Removable full-size CD-ROM drive, enhanced video, stereo speakers, MIDI/joystick port and lots more multimedia software!

Processor	Screen	Hard Drive
486DX4/100	10.4" Dual Scan	340MB
486DX4/100	10.4" Dual Scan	540MB
486DX4/100	10.4" Dual Scan	810MB
486DX4/100	10.4" Active	340MB
486DX4/100	10.4" Active	540MB
486DX4/100	10.4" Active	810MB
486DX4/100	10.4" Active	540MB*
486DX4/100	10.4" Active	810MB*

CALL for latest pricing

* 755CD features BUILT-IN CD-ROM Drive

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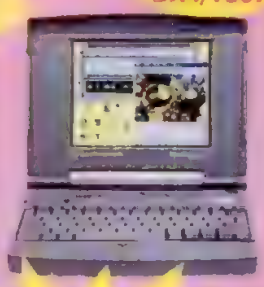
NEW DX4/100!

- ▲ Brilliant color display
- ▲ 16-bit sound card
- ▲ Integrated Pointing device
- ▲ 2 Type II or 1 Type III PCMCIA slot

as low as $2549

Processor	Screen	Hard Drive	Price
486DX2/50	9.5" Dual Scan	340MB	$2549
486DX2/50	8.4" Active	455MB	3219
486DX4/75	9.5" Dual Scan	455MB	3399
486DX4/75	8.4" Active	340MB	4099
486DX4/75	8.4" Active	455MB	4249
486DX4/100	9.5" Active	525MB	5549

Business Lease: $94/mo.



TM 4000M

CD-ROM Docking System

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- ▲ Double-speed CD-ROM drive
- ▲ 250ms access time
- ▲ Built-in speakers
- ▲ SCSI II connector

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TM 4000M
Shown with optional docking system

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Dependable and Hassle Free

ProLinea Desktops

- ▲ 4MB RAM expandable to 100MB
- ▲ 3.5" floppy drive
- ▲ Local bus graphics
- ▲ Pentium upgradable
- ▲ Energy Star compliant
- ▲ MS DOS 6.0, Windows 3.1

Processor	RAM	Hard Drive	Price
486SX/33	4MB	270MB	$1059
486SX2/50	4MB	270MB	1169
486DX2/50	4MB	420MB	1379
486DX2/66	4MB	420MB	1499
486DX2/66	4MB	525MB	1639

Compaq monitors start at $279.99

Contura 400

- ▲ 486DX2/40 processor
- ▲ 4MB RAM expandable to 20MB
- ▲ 2 Type II or 1 Type III PCMCIA slot
- ▲ Large built-in trackball
- ▲ MS-DOS, Windows 3.1, Tabworks, Lotus Organizer

Display	Hard Drive	Price
9.5" Dual Scan	250MB	$2459
8.4" Active	250MB	3119

Business Lease: $90/mo.

LTE Elite

- ▲ 4/8MB RAM exp. to 20/24MB
- ▲ Built-in AC adapter
- ▲ Removable hard drive
- ▲ 2 Type II or 1 Type III PCMCIA slot
- ▲ Integrated trackball
- ▲ MS-DOS 6.2, Windows 3.1, MS Video for Windows Run Time, Tabworks

Processor	Screen	Hard Drive	Price
486DX2/40	9.5" Dual Scan	170MB	$2739
486DX2/40	8.4" Active	170MB	3199
486DX2/40	8.4" Active	340MB	3689
486DX2/50	9.5" Active	340MB	4499
486DX4/75	9.5" Active	340MB	5099
486DX4/75	9.5" Active	510MB	5479

Business Lease: $100/mo.

Contura 400

COMPAQ

NEC

Pentium Power and Unparalleled Displays

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NEW!

as low as $3589

- ▲ 2 Type II or 1 Type III PCMCIA slot
- ▲ Removable hard drive and floppy drive
- ▲ Removable screen
- ▲ Integrated speaker, microphone
- ▲ MS-DOS, Windows 3.1, Windows Sound System, MS Video for Windows Run Time

Processor	Hard Drive	Screen	Price
486DX4/75	340MB	Dual Scan	$3589
486DX4/75	540MB	Active	4729
486DX4/75	540MB	High Res.	5099
486DX4/100	810MB	Active	5569
Pentium 75	540MB	Active	5389
Pentium 75	810MB	Active	5899

Business Lease: $118/mo.

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Ready Multimedia Desktops

- ▲ NEC CD-ROM drive
- ▲ SoundBlaster 16 sound card
- ▲ Speakers, microphone
- ▲ Fax modem
- ▲ MS-DOS, Windows, Quicken and more
- ▲ CD titles: Compton's Encyclopedia, PFS Window Works

Processor	Hard Drive	Price
486SX/33 Desktop	270MB	$1299
486DX2/66 Desktop	340MB	1479
486DX2/66 Minitower	420MB	1539
P60 Minitower	420MB	1899

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PCM 3/958

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as low as $2499

- ▲ 4MB expandable to 20MB
- ▲ 2 Type II or 1 Type III PCMCIA slot
- ▲ Removable hard drive
- ▲ Removable floppy – add second battery
- ▲ MS-DOS 6.21, Windows 3.1

Processor	Screen	Hard Drive	Price
486DX2/50	9.5" Dual Scan	250MB	$2499
486DX2/50	9.5" Dual Scan	340MB	2669
486DX2/50	9.5" Active	250MB	3199
486DX2/50	9.5" Active	340MB	3399
486DX2/50	9.5" Active	540MB	3779
486DX4/75	9.5" Active	340MB	3879
486DX4/75	9.5" Active	540MB	4199

Business Lease $92/mo.

Versa V

Versa S

Full Sized Notebook Features at only 4.7 lbs.

- ▲ Upgradable hard drive
- ▲ SurePoint integrated pointing device
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- ▲ Only 4.7 lbs.

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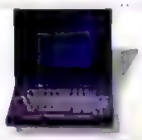

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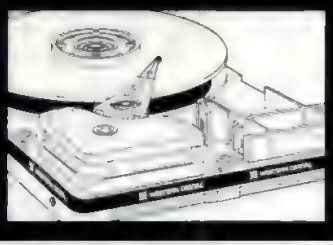

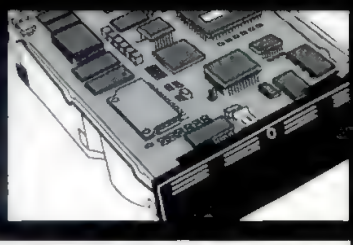

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1280MB	10ms	AC31200	$455

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270MB	SQ3270S	$369	$519	$489
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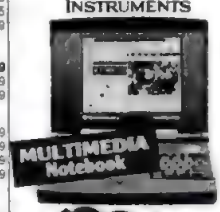

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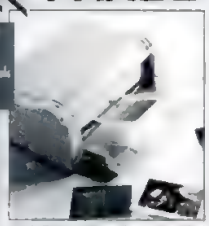

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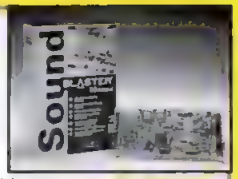

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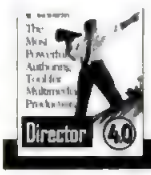

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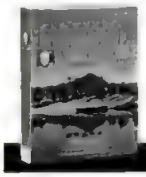

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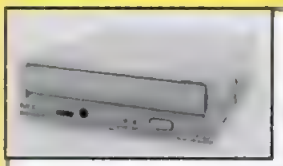

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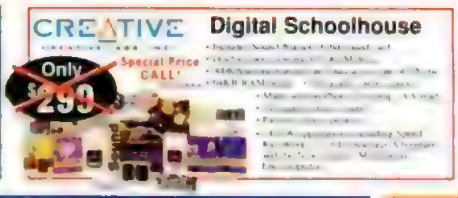

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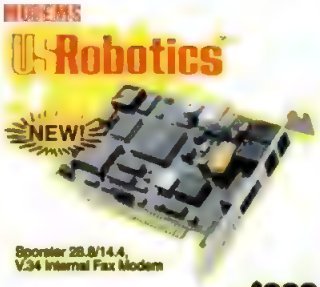

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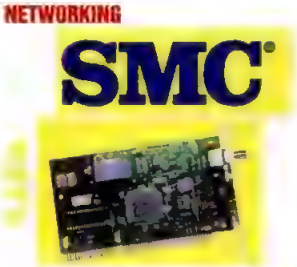

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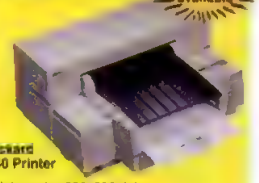

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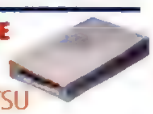

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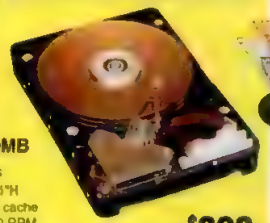

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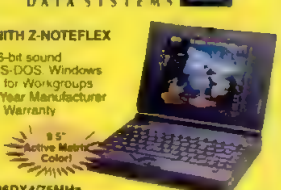

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426MB	IDE	CFS420A	14ms	3.5" 1"H	$199
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850MB	IDE	CFA850A	10ms	3.5" 1"H	309*
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850MB	IDE	MX7850AV	12ms	3.5" 1"H	299*
1260MB	IDE	MX71260A	12ms	3.5" 1"H	449*
Quantum					
420MB	IDE	QULT420A	12ms	3.5" 1"H	$199
540MB	IDE	QULT540A	11ms	3.5" 1"H	239*
730MB	IDE	QULP730A	11ms	3.5" 1"H	289*
Seagate					
420MB	IDE	ST3491A	13ms	3.5" 1"H	$199
545MB	IDE	ST3660A	14ms	3.5" 1"H	209*
722MB	IDE	ST3780A	12ms	3.5" 1"H	279*
850MB	IDE	ST5850A	12ms	3.5" .75"H	299*
1083MB	IDE	ST31220A	12ms	3.5" 1"H	399*

Capacity**	Interface	Model	Access	FF/Height	Bare
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FUJITSU					
530MB	SCSI	FJ8864S	12ms	3.5" 1"H	$239
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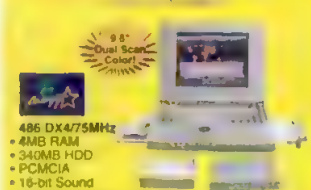

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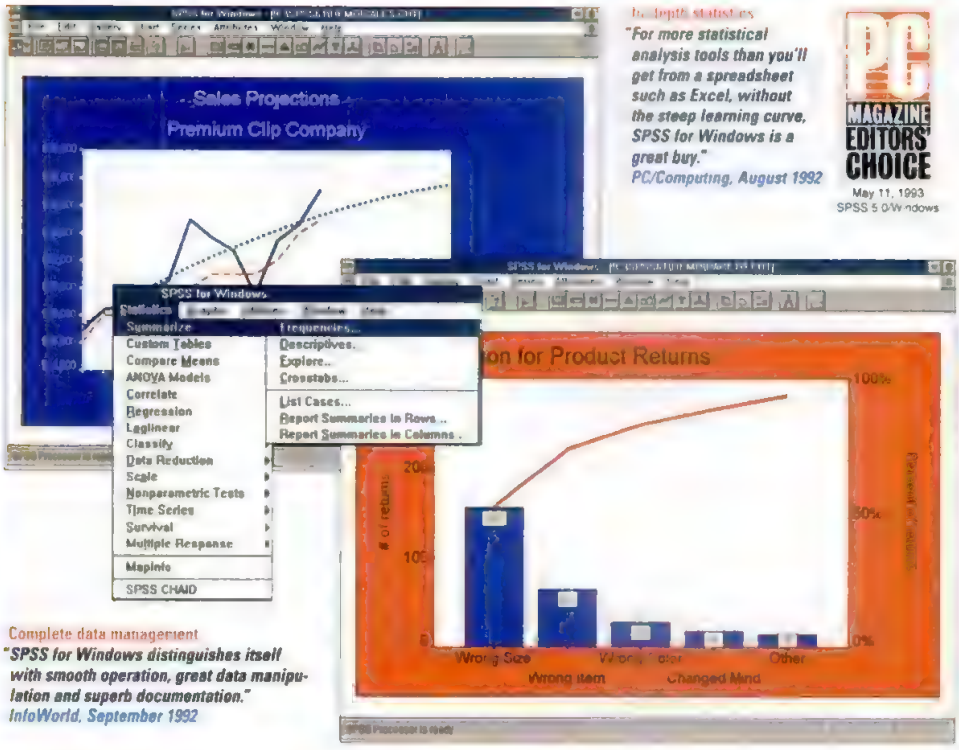

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All the employees at the Computer Discount Warehouse are still in school. No, they're not teenagers anymore, but they're all enrolled in a program called CDW University — which they also call "Customer U."

"We believe that the only way to grow is to make the customer #1," says Michael Krasny, the company's CEO. "That's why we established an on-going, mandatory training program that focuses on customer service and product briefings. Our employees also have personal, hands-on experience of a lot of the products they sell — and they know how to treat the customer right."

The customer support program at CDW, a ten-year-old reseller of PC hardware and software, includes free technical support from 8 a.m. to 7:30 p.m. "We guarantee that support calls will be answered within three minutes," says Krasny. He also points out that a $10 million product inventory makes it possible for the company to provide same-day order shipment.

Computer Discount Warehouse has turned their success into an opportunity to offer better customer service, and Krasny singles out his advertising in PC Magazine as the cornerstone of his success. "We've been in the PC Direct section since 1986, and we've never missed an issue. Our most loyal customers, the ones who appreciate service, come to us through PC Magazine. No matter how you look at it — closing rate, calls per ad dollar — PC Magazine is tops."

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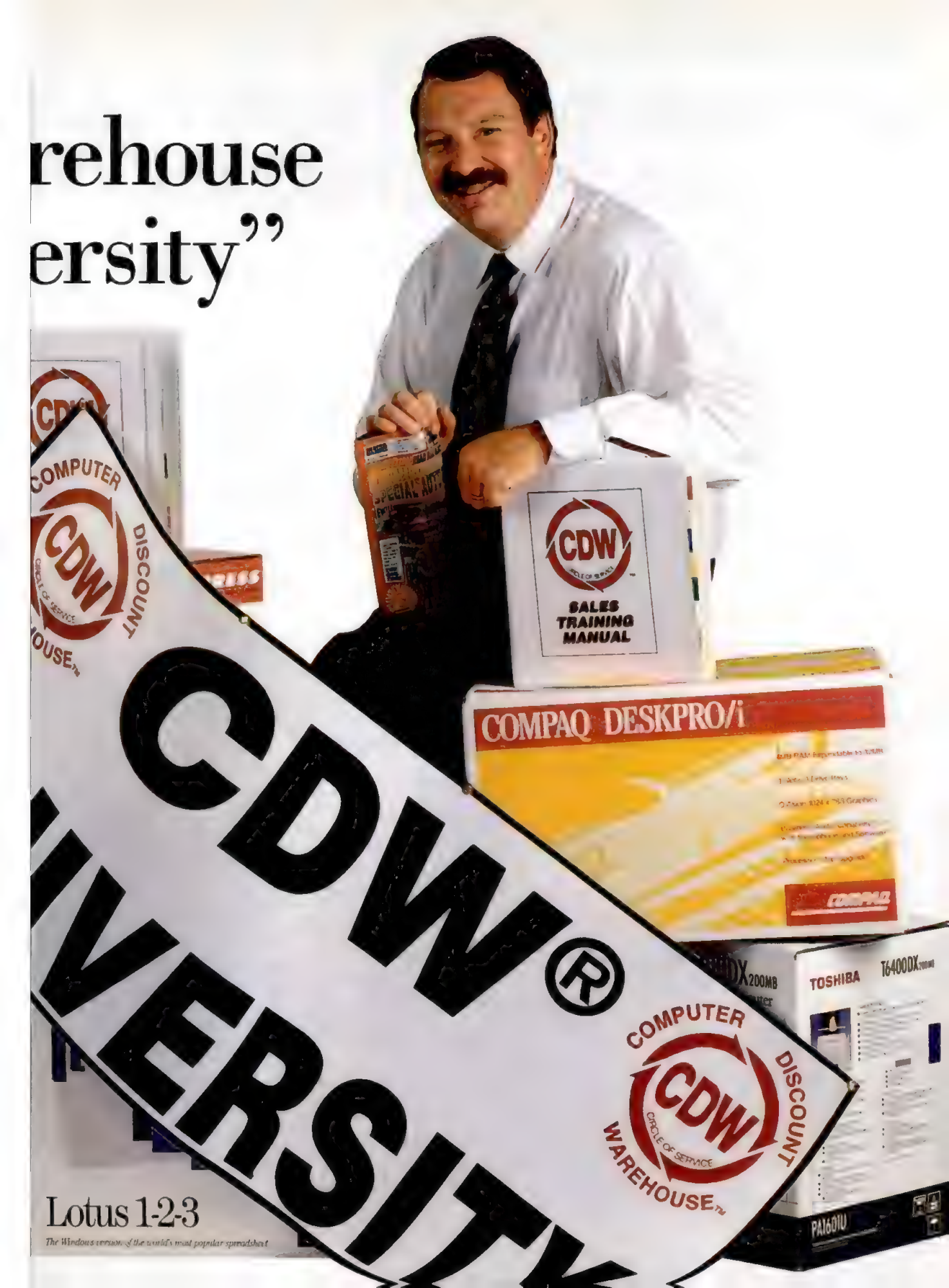
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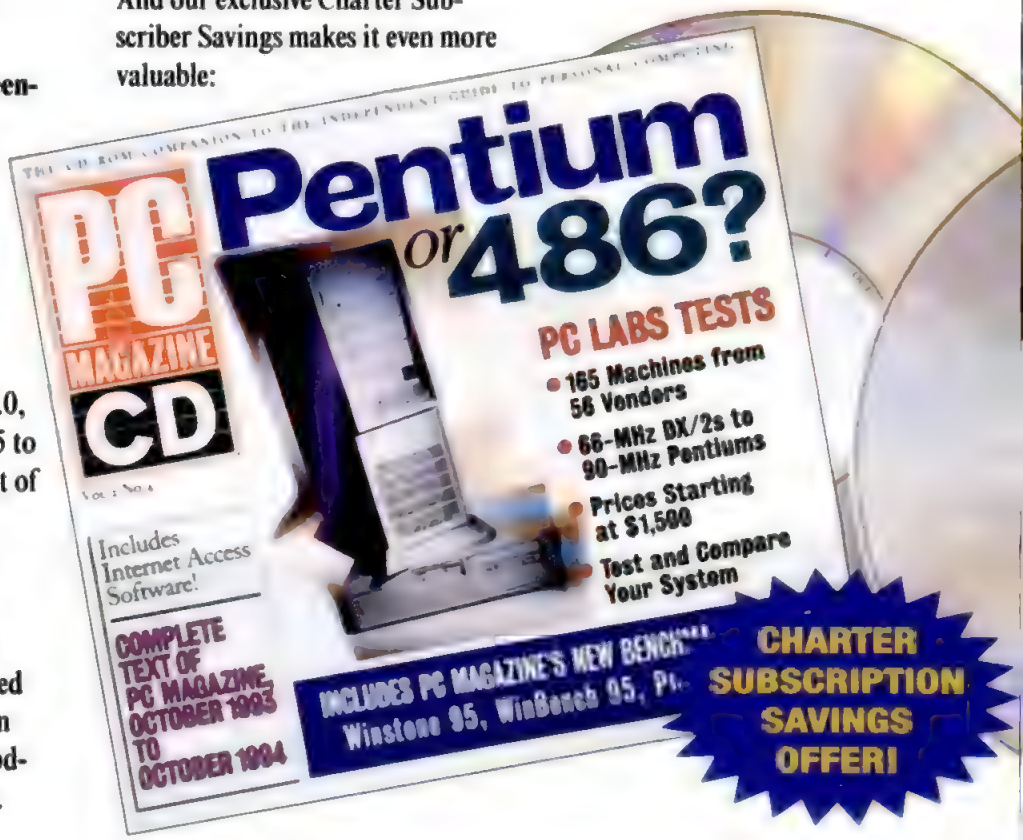

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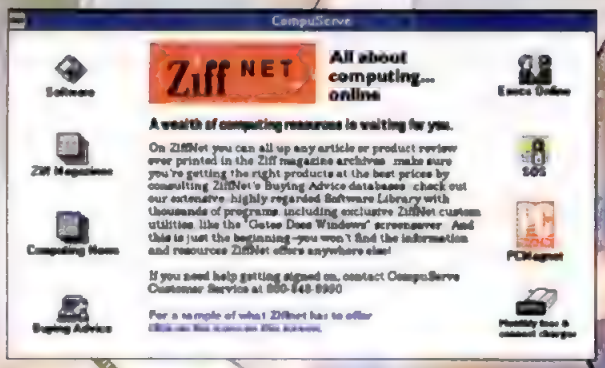

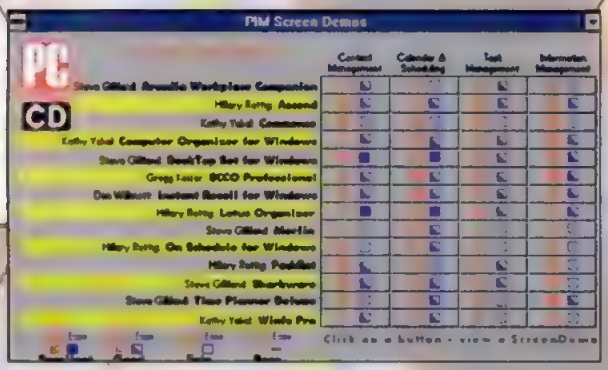

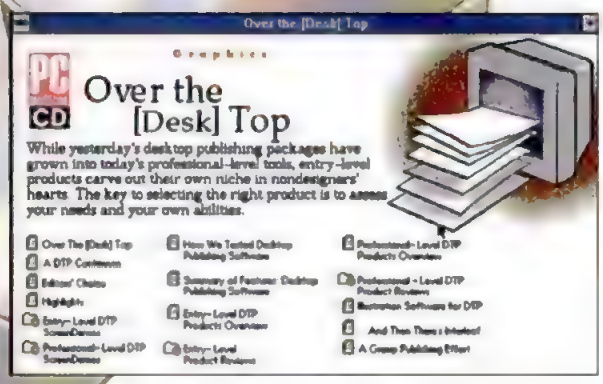

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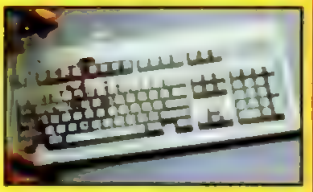

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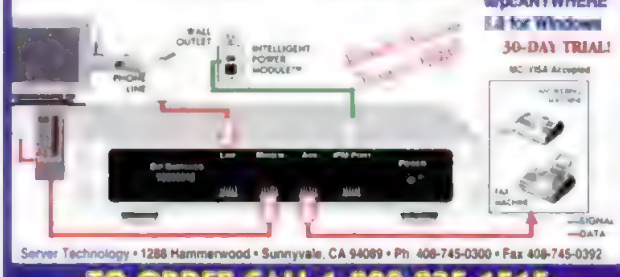

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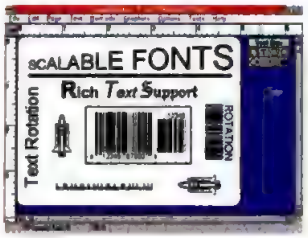

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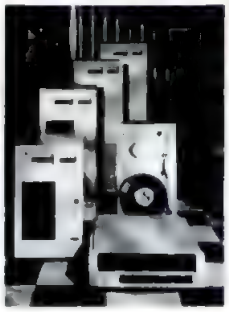

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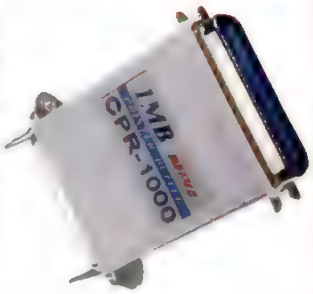

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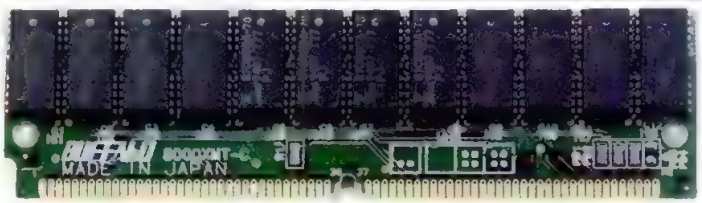

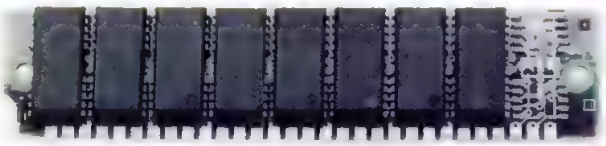

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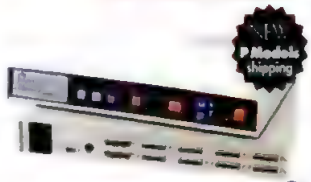

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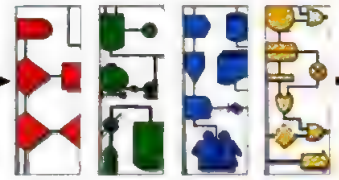

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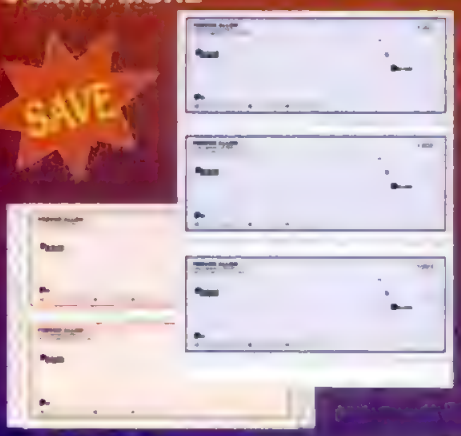

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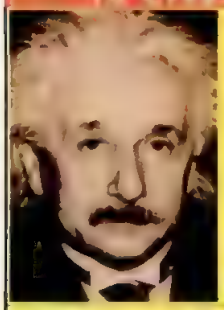

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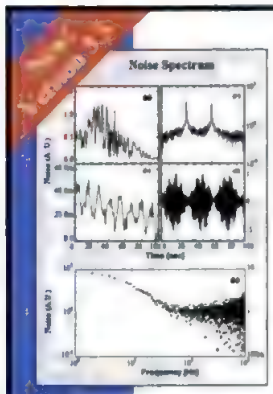

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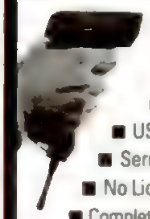

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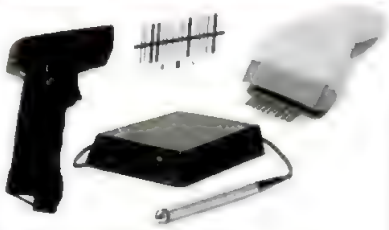

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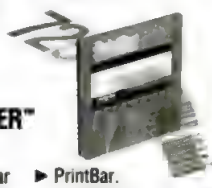

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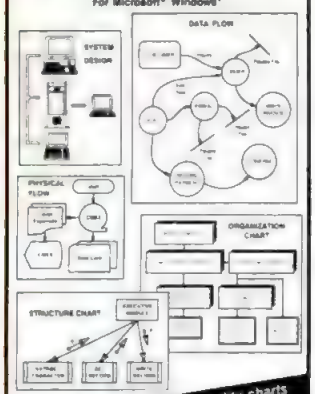

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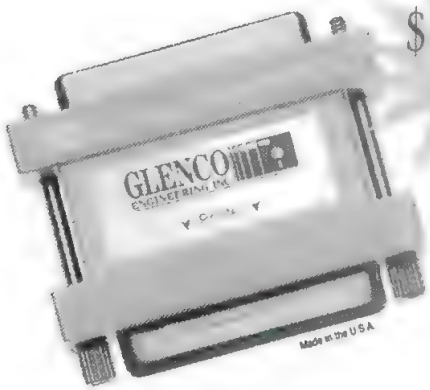

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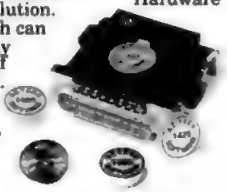

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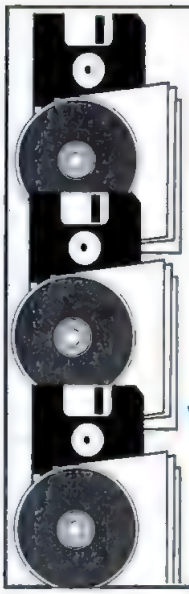

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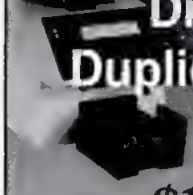

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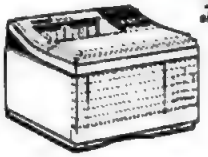

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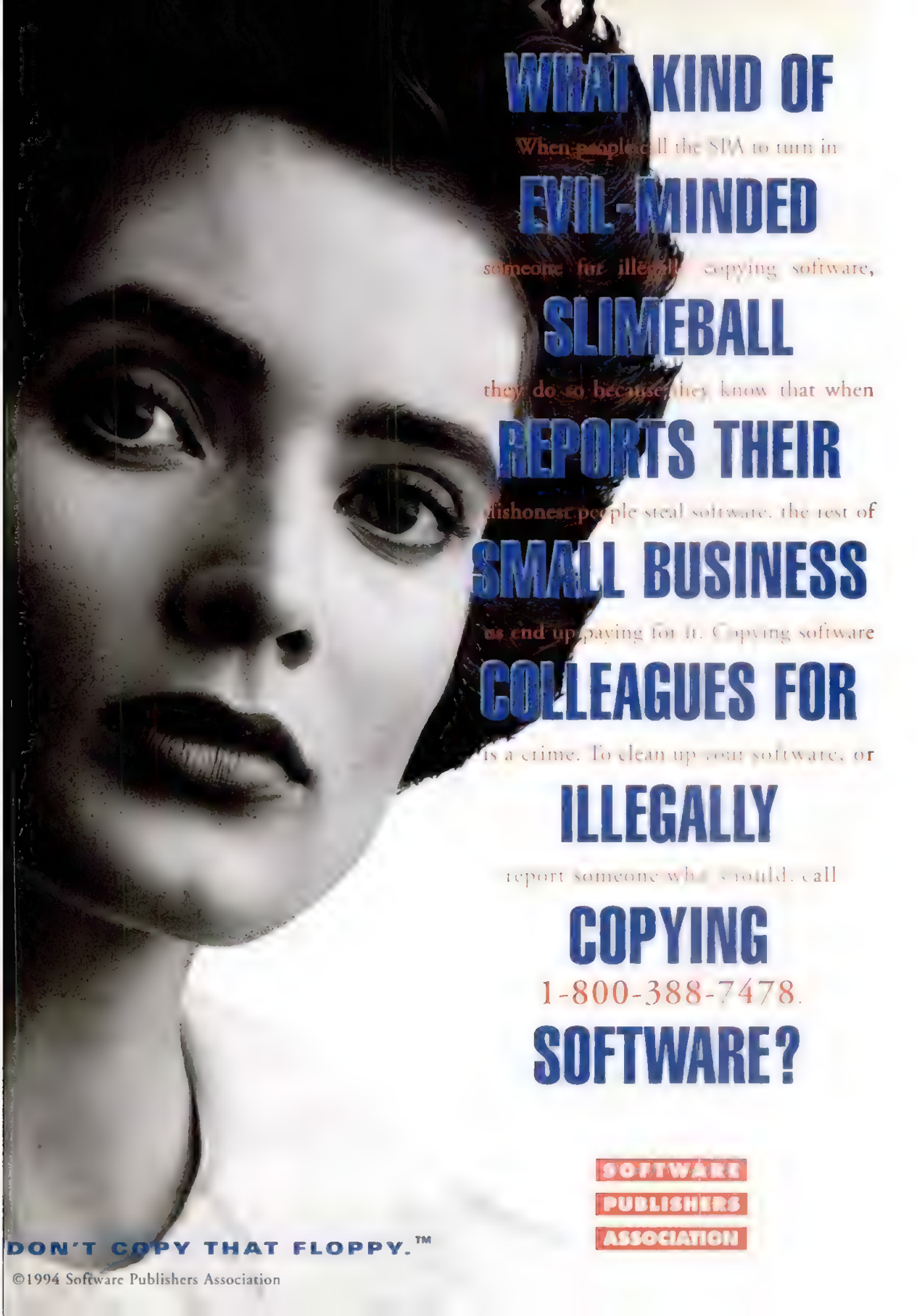
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PC MAGAZINE

Coming Up

Digital Video Capture and Editing

If you love to steal the show, you'll probably find that great videos are your best medium. The current batch of video-capture boards and video-editing software packages bring video down to the affordable, accessible level of business presentations. But they don't stop there: More and more, the PC-based components of a video production system can even let you produce professional-level videos. We take you through the steps of video editing, review nearly a dozen video-capture boards and a collection of video-editing packages, and discuss the mysteries and benefits of the MPEG compression standard. We also examine extra tools that let you morph, warp, and add other effects to your videos.

Getting Organized

You've just been assigned a huge project with what seems to be an unreasonable deadline, and the kicker is—you've never done this before. How do you determine how long it should take to do each part of the project, who should work on what, and whether the deadline truly is unreasonable? The answer: project management software. In the past, there have been primarily high-end offerings in this category, but the times are changing. This year we look at six mainstream packages that can help you get organized and plan your project, even if you've never used project management software before. We also examine some of the add-ons and high-end packages available.

C++ Programming

C++ programming tools have gotten even sharper since our last annual roundup. Graphical IDEs are here to stay—and they're better integrated and more full-featured than ever. The C++ language is also better supported, and the application framework wars are headed for a truce as most vendors move to MFC. But there are still plenty of differences in features, performance, and platforms to consider when picking a C++ environment. To help you make your choice, here's a comprehensive testing-based survey of today's state of the art in C++.

Coming Soon: A New Kind of Application

The Windows 95 shell extensions have the potential to change not only the way application programs work but even the way people perceive how programs work. PC Tutor Jeff Prosise explores some of the intriguing possibilities these extensions present for developers and users.

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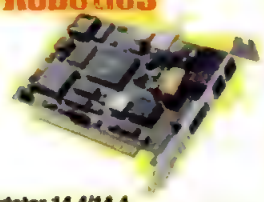
U.S. Robotics



Sportster 14.4/14.4 Internal Modem MIDUSR0278 $99

U.S. Robotics

MOTOROLA

Fastalk II 14.4/14.4 Ext. Faxmodem $119
Fastalk II 14.4/14.4 Int. Faxmodem 99
Cellect 14.4 Cellular Pocket Modem 299

UPS

APC
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Professional SurgeArrest 29
Professional SurgeArrest w/ Modem 39

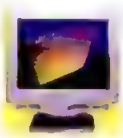
MONITORS

CTX

15", .28, 1024 x 768, NI CM1565GM $319
17", .28, 1280x1024, NI CM1765GM 649

MAGNAVOX
Smart.Very smart.

15" Monitor
.28 dot pitch, 1024x768 resolution, Non-interlaced



CMMA2015 $289

MAGNAVOX
Smart.Very smart.

15", .28, 1280x1024, NI CMMA4015 ..... $349
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17", .26, 1280x1024, NI CMDX17 599
21", .28, 1600x1200, NI CMMX21F 1,699

SONY

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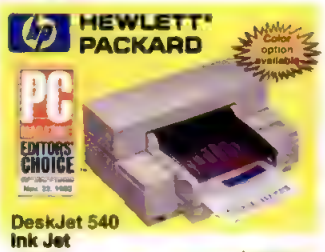

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• 3ppm
HPDJ540 $289

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OKIDATA

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ML 590 Dot Matrix 24-pin 360 CPS 429
OL400E LED 4ppm 512k 409
OL410E LED 4ppm 2MB 539
OL810 LED 8ppm 2MB 929
OL850 LED 8ppm 2MB 1,239

TEXAS INSTRUMENTS

MicroWriter LED 5ppm 512K $469
MicroWriter PS23 LED 5ppm 2MB 609
MicroLaser Pro E 12ppm 3MB 1,339
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Canon

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LBP 1260-Laser 12ppm 2MB 1,289

EPSON

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• Unrestricted access
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TEAC

CD55 Superquad 4x CD-ROM w/controller $279

PLEXTOR

4-Plex Internal w/256K Cache $339
Internal PX-43CH - 16 SCSI 469

TOSHIBA

Model 3401 Bare ..... $289 w/controller $349
Internal Quad Drive Bare ... 379 16 bit kit 439

SONY

SCSI CD-ROM Bare ..... $189 16 bit kit $249

Talon

Internal Quad Drive w/16 bit sound card $249

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Fujitsu Int. MO 230MB (PC) w/2 Cart. $799
Fujitsu DynaMO 230 (Mac) w/1Cart. 799
Fujitsu DynaMO 230 (PC) w/1 Cart. 849

IDE HARD DRIVES

WESTERN DIGITAL

1080MB
• 10ms
• 3.5" 1"H
• 128k cache
• 4,500 RPM
• Enhanced IDE
WD31000A $399

HARD DRIVES International

The Mass Storage Experts.

Capacity**	Interface	Model	Access	FF/Height	Save
WESTERN DIGITAL					
420MB	IDE	WD2420A	13ms	3.5" 1"H	$189
540MB	IDE	WD2540A	11ms	3.5" 1"H	209*
730MB	IDE	WD2700A	10ms	3.5" 1"H	279*
850MB	IDE	WD2850A	10ms	3.5" 1"H	299*
1080MB	IDE	WD31000A	10ms	3.5" 1"H	399*
COMMER					
426MB	IDE	CFS420A	14ms	3.5" 1"H	$199
540MB	IDE	CFA540A	14ms	3.5" 1"H	219*
850MB	IDE	CFA850A	10ms	3.5" 1"H	309*
1275MB	IDE	CFA1275A	10ms	3.5" 1"H	499*
Maxtor					
425MB	IDE	MX7425AV	12ms	3.5" 1"H	$199
540MB	IDE	MX7540AV	12ms	3.5" 1"H	219*
850MB	IDE	MX7850AV	12ms	3.5" 1"H	299*
1260MB	IDE	MX71260A	12ms	3.5" 1"H	449*
Quantum					
420MB	IDE	QULT420A	12ms	3.5" 1"H	$199
540MB	IDE	QULT540A	11ms	3.5" 1"H	239*
730MB	IDE	QULP730A	11ms	3.5" 1"H	299*
Seagate					
420MB	IDE	ST3491A	13ms	3.5" 1"H	$199
545MB	IDE	ST3660A	14ms	3.5" 1"H	209*
722MB	IDE	ST3780A	12ms	3.5" 1"H	279*
850MB	IDE	ST5850A	12ms	3.5" .75"H	299*
1083MB	IDE	ST31220A	12ms	3.5" 1"H	399*

*Bundled with GSI Model 16 IDE Accelerator

DOOM II: Hell on Earth

In the annals of computer entertainment, there's no game that had the rave following quite like DOOM. There's also no game that's quite as breathlessly awaited as its sequel.

214223 $45

SCSI HARD DRIVES

Seagate BARRACUDA

4294MB
• 8ms
• 3.5" HH
• 1,024k cache
• 7,200 RPM
• Fast SCSI-2
ST15150N $2,099

Capacity**	Interface	Model	Access	FF/Height	Save
MICROPOLIS					
2100MB	SCSI	MC4221S	8.5ms	3.5" 1"H	$1,099
4300MB	SCSI	MC3243S	8.5ms	3.5" HH	1,999
9100MB	SCSI	MC1991	12ms	5.25" FH	3,199
COMMER					
1080MB	SCSI	CFP1080S	9.5ms	3.5" 1"H	$539
2147MB	SCSI	CFP2106S	8.5ms	3.5" 1"H	999
4294MB	SCSI	CFP4294S	9ms	3.5" HH	2,299
FUJITSU					
530MB	SCSI	FJ2664S	12ms	3.5" 1"H	$299
1080MB	SCSI	FJ2694S	10ms	3.5" HH	539
Quantum					
730MB	SCSI	QULT730S	11ms	3.5" 1"H	$329
1080MB	SCSI	QUEM1080S	9.5ms	3.5" 1"H	539
1440MB	SCSI	QUEM1440S	9.5ms	3.5" 1"H	739
2100MB	SCSI	QUEX2100S	9.5ms	3.5" HH	949
4280MB	SCSI	QUGP4280S	8.5ms	3.5" HH	2,099
Seagate					
545MB	SCSI	ST5660N	12ms	3.5" .75"H	$279
1050MB	SCSI***	ST31250N	8ms	3.5" 1"H	829
1052MB	SCSI	ST31230N	9ms	3.5" 1"H	539
2100MB	SCSI	ST32430N	9ms	3.5" 1"H	949
2134MB	SCSI	ST12450W	9ms	3.5" HH	1,399
2145MB	SCSI***	ST32550N	8ms	3.5" 1"H	1,099
4294MB	SCSI	ST15230N	9ms	3.5" HH	1,779
4294MB	SCSI***	ST15150N	8ms	3.5" HH	2,099
9080MB	SCSI	ST410800N	11ms	5.25" FH	3,299

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After Hours

EDITOR'S RATINGS: ★ Poor ★★ Fair ★★★ Good ★★★★ Excellent

DOS Windows CD-ROM Resource-Intensive Adult Content Kids (Ages) Price

An A for Experimentation: Science Software for Kids

You're never too young to start learning about science. These five programs aimed at children teach everything from basic nutrition to how weather works in amusing and highly visual ways. The best science programs explain complex concepts through activities and experiments, not just through endless strings of facts. To keep the learning going when the PC is turned off, look for programs that offer ideas for further exploration.

Ozzie's World

Digital Impact Inc.; 800-775-4232.

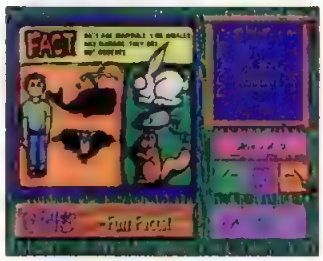
Circle 496 on reader service card

★★★★ Windows CD-ROM Kids (Ages) $59.95

Ozzie is a sea otter with a bent for science who will lead your children on a series of explorations. Kids can explore five environments: a beach, a forest, a garden, a veterinarian's office, and Ozzie's bedroom. In each of these areas, kids will find games to play, pictures to color, and science experiments to perform.

The games are challenging yet encouraging versions of classics, which ask children to match pairs or find hidden pictures. Kids receive hints along the way and rewards when they complete an activity. To level the playing field, you can set a different difficulty level for each player.

While the games are fun, what truly sets Ozzie's World apart is its science experiments. The program takes some very complex theories and translates them into activities that teach young children about science and ecology clearly and enjoyably. The experiments are varied and, most important, fun: making a rain forest in a soda bottle, designing an underwater viewer, and others. The program also has a guide with descriptions of the activities, experiments, and stories parents can read to their children to encourage further exploration.



Ozzie's World helps you learn fun facts about animals.

Scholastic's The Magic School Bus Explores the Human Body

★★★★ Windows CD-ROM Kids (Ages) $49.95

Scholastic's The Magic School Bus Explores the Solar System

★★★★ Windows CD-ROM Kids (Ages) $49.95

Microsoft Corp.; 800-426-9400.

Circle 495 on reader service card

Everybody on the bus for a far out—and far in—ride through space and the human body. Scholastic's The Magic School Bus Explores the Solar System and The Magic School Bus Explores the Human Body use film clips, animations, still photographs, and illustrations to take kids on two rides they'll never forget.

The programs feature the zany, wacky, I'm-not-afraid-of-anything teacher Ms. Frizzle (the Friz) and her class as they hop on the Magic School Bus to explore, learn, and just have fun. In The Human Body, the magic bus, Ms. Frizzle, and the class are magically shrunk, mistaken for a Cheesie Weesie, and swallowed by the snack-happy Arnold. Once inside Arnold, the Friz and her class explore 12 parts of the body as they search for a way out. Along the way, the class conducts science experiments, presents multimedia reports, and plays games at each body part.

In The Solar System, the class is headed for the planetarium when the bus suddenly turns into a space ship and blasts off—losing Ms. Frizzle somewhere in space. As they explore the planets, gathering information in the process, the class earns tokens to feed into the Friz Finder, which will help them locate the missing teacher. As in The Human Body, information is conveyed through games, activities, and multimedia reports.

When you're at the controls of the Magic School Bus, you decide where to explore next.

Both programs are extremely well designed, engaging, and

AFTER HOURS INDEX

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highly interactive. Kids control their own adventures, taking a hand in everything from driving the bus to deciding how information is presented.

Zurk's Rainforest Lab

Soleil Software Inc.; 415-494-0114.

Circle 497 on reader service card

★★★★ WIN $40.00

Zurk, the delightful character who first appeared in Zurk's Learning Safari, is now back in Zurk's Rainforest Lab. Here the well-dressed character is joined by Nita the margay (a wild cat) and Mico the monkey on a trip through the Central American rain forest.

Help Nita the margay find all the eggs hidden in this activity in Zurk's Rainforest Lab.

Zurk's Rainforest Lab opens in the Mercado (marketplace). From here, you can travel to any of the program's five activity centers: Jungle Discovery, Egg Hunt, Seek and Sort, Pattern Puzzles, and Photo Album. Jungle Discovery lets children freely move through the floor, understory, and canopy of the rain forest, where they learn about the animals and plant life in text and sound. They can also snap a picture of an animal and view and document it in the diary-like Photo Album. In the Egg Hunt, kids use their problem-solving skills to unearth 12 hidden eggs; in Seek and Sort, they must identify and sort various categories of rain forest animals. In Pattern Puzzles, kids learn early geometry by putting together shape puzzles.

Zurk offers encouragement in English, Spanish, and French, and the characters talk directly to the children. In the Egg Hunt, for example, Nita the margay looks directly at the player and asks "Will you help me?" In addition to offering sound learning, this program is visually breathtaking; the backgrounds and characters are all rendered in vibrant watercolors that add to the storybook atmosphere.

Sammy's Science House

Edmark Corp.; 800-426-0856.

Circle 498 on reader service card

★★★ CD WIN $35.00

Younger kids who want to learn basic scientific concepts and skills should meet Sammy the Snake. Sammy will gladly guide preschoolers through five activities that teach science fundamentals such as observation, classification, comparison, and sequencing.

In the Workshop, kids learn about putting things together as they make toys. At the Acorn Pond, kids watch the seasons change and see how these changes affect the animals. For learning more about weather conditions, there's the Weather Machine. Learning to classify plants, animals, rocks, and flowers is the goal of the Sorting Station, while learning sequencing is the name of the game in Make-a-Movie.

PROBLEM SOLVER

If you're playing Zurk's Rainforest Lab and can't find all the eggs in the Egg Hunt, have the cub knock on the door in the tree trunk. Zurk will guide you to the hidden eggs.

As with Millie's Math House and Bailey's Book House—the other programs in this series—Sammy's Science House offers two modes of play: Explore and Discover, which lets kids set the pace as they wander through activities, and Question and Answer, in which the program's characters ask kids to perform specific tasks while offering hints and feedback.

Use the Weather Machine in Sammy's Science House to create your own weather.

All the instructions are spoken by the program, so prereaders can play by themselves; the user guide includes activities for parents and children to explore together. Despite these pluses, there just isn't enough variety to keep little scientists involved for very long.

Dr. Health'nstein's Body Fun

StarPress Multimedia Inc.; 800-782-7944.

Circle 499 on reader service card

★★★ WIN $49.95

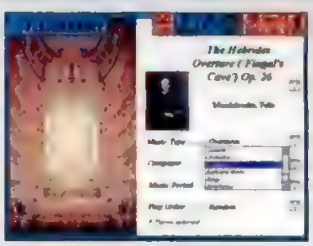
If you've ever wondered about the adage "you are what you eat," Dr. Health'nstein's Body Fun will bring the point home to you in record time. Starting out when you're ten years old, Body Fun shows you the effects that food, exercise, and bad habits, such as smoking, have on your body as you grow older.

Body Fun combines humorous animation with a serious look at nutrition. The program's activities ask you to select various foods and measure their nutritional values. The more nutritionally sound

An Introduction to Classical Music

CD-ROM PICK HIT

For a music appreciation course on CD-ROM, look no further than An Introduction to Classical Music. This disk features 4 hours of musical excerpts from 45 different composers of the Baroque, Classical, Romantic, and Modern periods, as well as a 10-minute introduction to classical music, a comprehensive index, and biographical material.



Select the type of music you want to explore—piano, chamber, ballet, or symphonic—and listen to examples while browsing through supporting material on the music and its composer.

This CD-ROM offers novices a friendly and delightful first exposure to classical music.—*Donald B. Trivette Compton's New Media; 800-862-2206.*

Circle 502 on reader service card

★★★★ WIN $49.95

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CHOOSY BUYER

LET'S FACE IT, today's business computer market is no picnic. In fact, with so much competition, product advertisers are finding it increasingly important to reach committed business buyers without waste. So when buyers cite certain magazines—Ziff-Davis magazines to be exact—as their preferred choice for purchasing information, advertisers take note. And action.

Business buyers who are involved in selecting computer products for their companies have a weighty responsibility. They must choose wisely. Because the wrong system, software or peripheral can lead to costly, career-threatening mistakes today and down the road.

In over 60 independent studies since 1987, buyers cite Ziff-Davis magazines as their preferred choice for purchasing information.

These buyers need timely, objective news and reliable product evaluations to guide their purchasing decisions. Which makes them very choosy about where they get their information.

They know some publications meet their needs better than others. Those are the ones they turn to first, trust the most and spend the most time reading.

Independent studies confirm that buyers prefer Ziff-Davis magazines.

In more than 60 independent studies conducted over the past six years, buyers have cited Ziff-Davis magazines as their number one choice for purchasing information. In many cases, Ziff magazines have been their choice by 2-to-1 or more over their nearest competitors.

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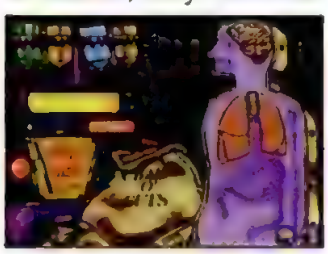
Standard multimedia image

GVision DX. The ultimate combination of full-screen, full motion MPEG digital video and 64-bit graphics acceleration.

the food you eat and the better the exercise program you establish, the better your Health Rating. Built-in aids, such as the automatic scoring of the nutrients in the foods you select and the BodyPuter, help you to see how you're doing; the Remote Body Monitor lets you travel into the future to see the effects your current diet and exercise plan will have in later years.

Designed in part by the Cancer Research Foundation of America, Body Fun is well written and gives older kids an insight into their health and nutrition. The one drawback is that screen redraws are painfully slow—slower than the cumulative effects of a bad diet.

—Charles Taft



In Body Fun's Rag o' Guts activity, players learn the location of various parts of the body.

Science

Get Under The Skin With A.D.A.M.

A.D.A.M. The Inside Story
A.D.A.M. Software Inc.;
800-755-2326, 404-980-0888.
Circle 500 on reader service card
★★★★ $79.00

The human body is an amazing thing—especially when you understand how it works. With A.D.A.M. The Inside Story, you'll not only learn

QUICK CLIPS

Defender of the Empire
This TIE Fighter add-on features three new multimission battles, a powerful new starfighter, and more foes than you can shake an Ewok at. You need the original to play, but it's worth the price. *$24.95; LucasArts; 415-721-3300.*

The Faces of *LIFE*
A comprehensive collection of covers and classic photos from 37 years of *LIFE* magazine on a single CD-ROM. Great idea, but the interface is a bit clunky, and for some reason, the captions are often unreadable. *$29.99; Creative Multimedia; 800-262-7668.*

Favorite Games
Visually pleasing but slow SVGA versions of checkers, rummy, and some other popular games. Sure they're cheap, but for less money you could download better, more interesting stuff from CompuServe or AOL. *$14.95; Expert Software Inc.; 800-759-2562.*

Rise of the Robots
You may just be a cyborg battling your way past a host of nasty robots in this fightfest, but the amazing graphics engine packs a serious punch. These are some of the best-rendered graphics ever seen in a PC game. *$49.95; Time-Warner Interactive; 800-482-7366.*

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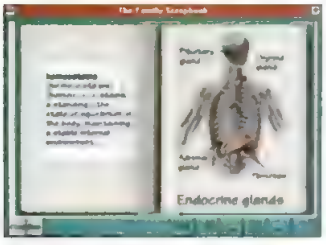
how your body reacts to everyday events, but you'll get to see it happen in full-color animations and videos.

An animated Adam and Eve are your guides in this interactive family learning tool. These amusing characters take you through a Family Scrapbook of animations that explain how the body works and reacts to events such as a bee sting or a sunburn.



A.D.A.M.'s Family Scrapbook is where to turn to learn about the functions of the body.

But these animations are not the most impressive part of the package. Perhaps the most useful and engaging tools in A.D.A.M. are the medical-quality anatomical illustrations. You can choose to explore either the male or female anatomy in front or back view, with a choice of skin tones. A simple click lets you identify body structures and peel away the skin to access the underlying body systems. There's a locking feature that turns off the sections on sex and reproduction (and covers the naughty bits with illustrated fig leaves).

For learning about the body, there's no better tool than A.D.A.M.

—Gayle C. Ehrenman

Action

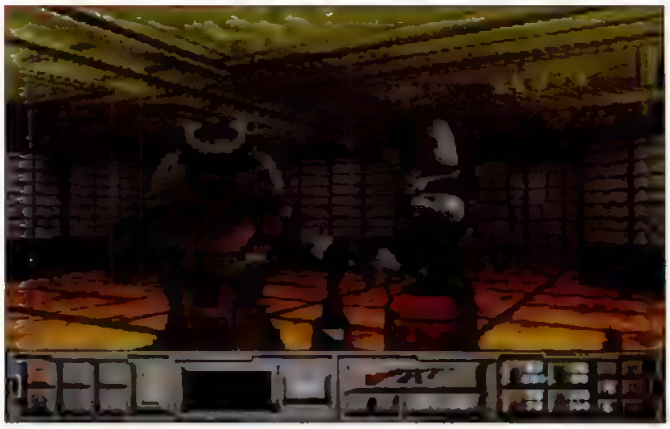
Shoot 'Em Up And Smile

The Fortress of Dr. Radiaki

Merit Software; 800-238-4277.
Circle 501 on reader service card
★★ $49.95

The Fortress of Dr. Radiaki is a first-person shoot-em-up reflex tester along the lines of id Software's DOOM. But Dr. Radiaki has a sense of humor.

This game puts you in the shoes of a bat-wielding secret agent sent to Dr. Radiaki's secret island to foil the mad doctor's plan for global nuclear destruction. Rather than being demonic, the enemies here are an amusing lot, ranging from whispering Ninjas, to toaster-headed robots, to cigar-chomping Cubans. Though these foes may be entertaining, they're not particularly attractive; in fact, the critters are hopelessly pixelated. The backdrops are a bit disappointing, too.



Beware the toaster heads in the Fortress of Dr. Radiaki.

Radiaki's choice of keyboard commands is less than intuitive for veterans players of 3-D maze games. Once you figure out which key controls your hero's gun, you still need to figure out how to aim it. This can be a frustrating process.

Still, The Fortress of Dr. Radiaki does a good job at creating a parody of the kill-or-be-killed genre of gaming. The humor is highly commendable, but the game play could use some improvement.

—Bernard H. Yee

SPOTLIGHT ON KIDS

JumpStart Kindergarten

JumpStart Kindergarten is a multimedia replica of a kindergarten classroom where kids can participate in typical learning activities to build their language, math, reading, and reasoning skills.

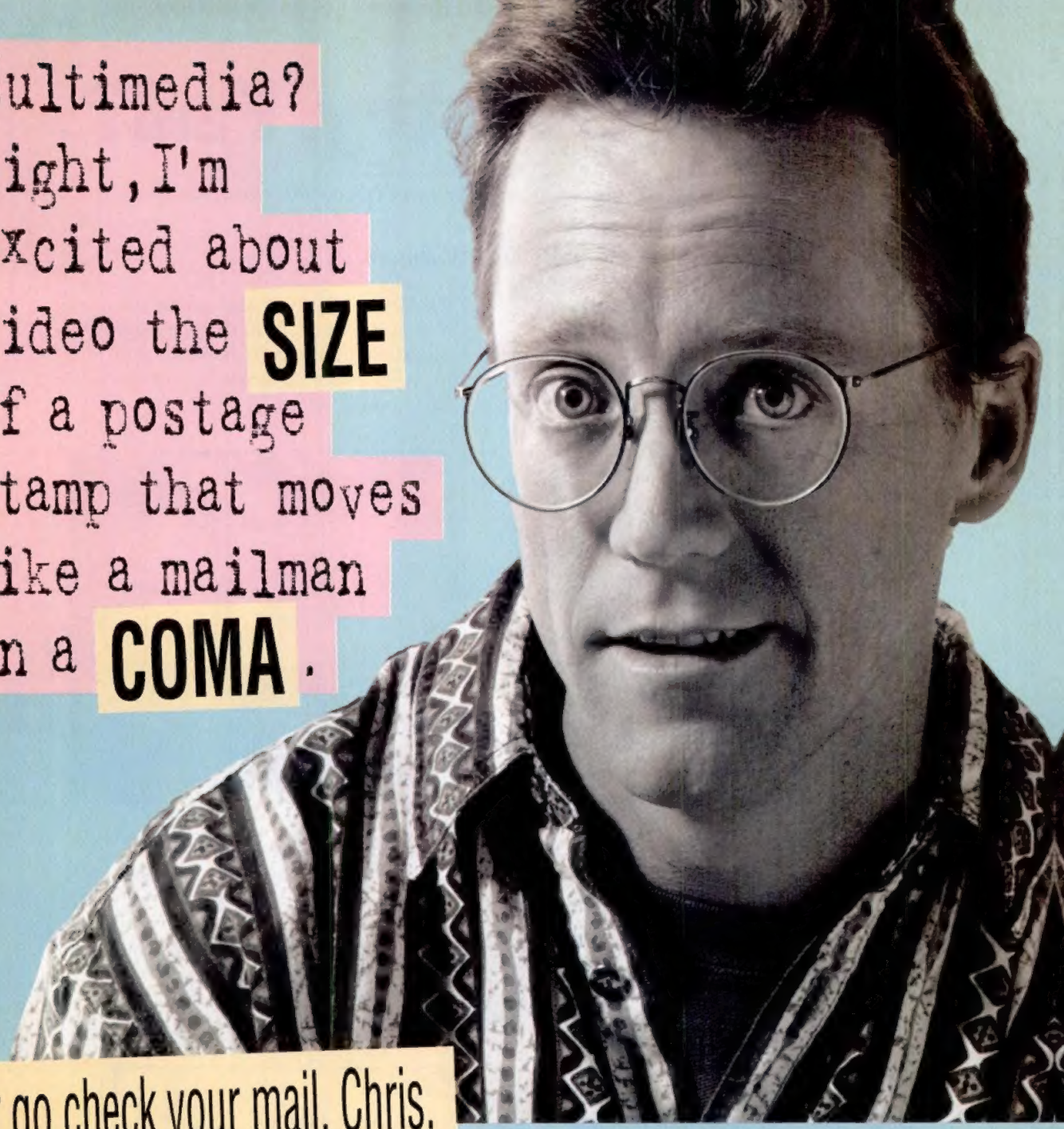
The program's main screen is a busy kindergarten classroom that includes a helpful rabbit teacher, a singing ABC banner on the wall, and even a bulletin board with art work appropriate to the season. Here, your child will count mice, match patterns, place objects in order, and learn about letters, numbers, and time. In the outdoor picnic area, a child can photograph an animal and paint the resulting picture. The puzzle game, perhaps the most versatile activity, involves matching pictures based on criteria such as color, number, size, shape, or rhyme. Success brings wild applause or a festive animation.

All of the activities adapt to your child's ability. Guess the correct plant to complete a pattern in the garden game, for example, and the next pattern will be more complicated. There are some sneaky surprises that reinforce learning: Try clicking on the teacher's ears, for example. You can monitor your child's progress by checking her report card. The program can track one child or a whole preschool class and can print reports for all of them.

JumpStart Kindergarten lets your youngsters enjoy playing school while getting a head start on kindergarten skills.*—Neil J. Rubenking*

Knowledge Adventure; 800-542-4240, 818-542-4200.
Circle 503 on reader service card
★★★★ $54.95

Multimedia? Right, I'm excited about video the **SIZE** of a postage stamp that moves like a mailman in a **COMA**.



Better go check your mail, Chris.

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REALmagic

As Big As It Gets

SIGMA DESIGNS

Abort, Retry, Fail?

THE LIGHTER SIDE OF PERSONAL COMPUTING

By Don Willmott

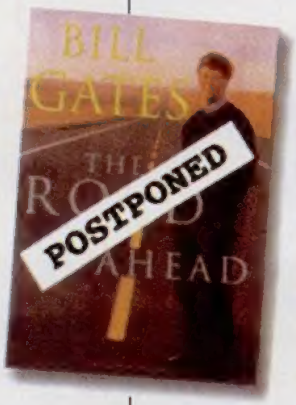
Mr. and Mrs. Feigenson, We Disapprove!

Faithful reader Alex Feigenson hand-wrote a submission to Abort, Retry, Fail? and added this poignant postscript: "P.S. Sorry about not sending a printout and disk. I am grounded so I can't use my computer. P.P.S. I am 13."

☞ Jonathan Frakes, Morgan Fairchild, and Joe Piscopo star in New World Computing's Multimedia Celebrity Poker (800-325-8898). Gee, we were kind of hoping for Nipsey Russell.

Classified Intelligence

"1 Month old 486 DX33, color monitor & printer, full tower, phone fax modem, much more. $1,800. Too stupid to use, bought Macintosh."—*The Houston Chronicle*



☞ A familiar ring: The Pacific Northwest Booksellers Association catalog notes a delay in the publication of Microsoft CEO Bill Gates's book.

Waku-Waku Revisited

Five issues ago we asked Japanese speakers to send in a definition for *waku-waku* (the amusing phrase that appeared in a video promoting IBM's OS/2 Warp). First to reply was Yoh Jinno, who tells us that the word *waku* literally means "to boil," but that *waku-waku* normally means "to get excited." *Domo arigato.*

☞ Don't turn a notebook PC on its side. All the good luck might spill out. (*InfoWorld.*)

Dude Looks like a Nerd

During an on-line conference for their fans, the members of Aerosmith struggled with the notebook PCs they'd been given. "What would you do if you didn't play rock and roll?" one on-line correspondent asked. "Learn to type" was the reply.

Richard Tennant

If your entry is used, we'll send you $50 and a *PC Magazine* T-shirt. Send your entries to Abort, Retry, Fail?, *PC Magazine,* One Park Ave., New York, NY 10016-5802. Winners this issue: Alex Feigenson, Michael Hartmann, R.P. Murlless Jr., George Pitlik, and Yoh Jinno.

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